The Honorable James M. Inhofe
Chairman
Committee on Armed Services
United States Senate
Washington, DC 20510

JUL 29 2019

Dear Mr. Chairman:

The enclosed report is in response to Senate Report 115–290, page 212, to accompany S. 3159, the Department of Defense (DoD) Appropriations Bill, 2019, detailing the scope and impact of respiratory illness on military personnel—particularly on deployed troops—dating from the first Gulf War to the present.

The report provides a detailed review of respiratory illness experienced by military personnel. The Department of Veterans Affairs and DoD have completed, and continue to be involved in, a number of health studies associated with respiratory exposures. Epidemiological studies, with and without associated clinical studies, have been conducted and include various timeframes from 2001 to the present, to evaluate potential respiratory diseases associated with historical exposures.

Thank you for your interest in the health and well-being of our Service members, veterans, and their families. A similar letter is being sent to the other congressional defense committees.

James N. Stewart
Assistant Secretary of Defense for Manpower
and Reserve Affairs, Performing the Duties
of the Under Secretary of Defense for
Personnel and Readiness

Enclosure:
As stated

cc:
The Honorable Jack Reed
Ranking Member

OFFICE OF THE UNDER SECRETARY OF DEFENSE
4000 DEFENSE PENTAGON
WASHINGTON, D.C. 20301-4000

PERSONNEL AND
READINESS

The Honorable Adam Smith
Chairman
Committee on Armed Services
U.S. House of Representatives
Washington, DC 20515

JUL 29 2019

Dear Mr. Chairman:

The enclosed report is in response to Senate Report 115–290, page 212, to accompany
S. 3159, the Department of Defense (DoD) Appropriations Bill, 2019, detailing the scope and
impact of respiratory illness on military personnel—particularly on deployed troops—dating
from the first Gulf War to the present.

The report provides a detailed review of respiratory illness experienced by military
personnel. The Department of Veterans Affairs and DoD have completed, and continue to be
involved in, a number of health studies associated with respiratory exposures. Epidemiological
studies, with and without associated clinical studies, have been conducted and include various
timeframes from 2001 to the present, to evaluate potential respiratory diseases associated with
historical exposures.

Thank you for your interest in the health and well-being of our Service members,
veterans, and their families. A similar letter is being sent to the other congressional defense
committees.

James N. Stewart
Assistant Secretary of Defense for Manpower
and Reserve Affairs, Performing the Duties
of the Under Secretary of Defense for
Personnel and Readiness

Enclosure:
As stated

cc:
The Honorable William M. "Mac" Thornberry
Ranking Member

PERSONNEL AND
READINESS

The Honorable Richard C. Shelby
Chairman
Subcommittee on Defense
Committee on Appropriations
United States Senate
Washington, DC 20510

JUL 2 9 2019

Dear Mr. Chairman:

The enclosed report is in response to Senate Report 115–290, page 212, to accompany S. 3159, the Department of Defense (DoD) Appropriations Bill, 2019, detailing the scope and impact of respiratory illness on military personnel—particularly on deployed troops—dating from the first Gulf War to the present.

The report provides a detailed review of respiratory illness experienced by military personnel. The Department of Veterans Affairs and DoD have completed, and continue to be involved in, a number of health studies associated with respiratory exposures. Epidemiological studies, with and without associated clinical studies, have been conducted and include various timeframes from 2001 to the present, to evaluate potential respiratory diseases associated with historical exposures.

Thank you for your interest in the health and well-being of our Service members, veterans, and their families. A similar letter is being sent to the other congressional defense committees.

James N. Stewart
Assistant Secretary of Defense for Manpower and Reserve Affairs, Performing the Duties of the Under Secretary of Defense for Personnel and Readiness

Enclosure:
As stated

cc:
The Honorable Richard J. Durbin
Vice Chairman

The Honorable Peter J. Visclosky
Chairman
Subcommittee on Defense
Committee on Appropriations
U.S. House of Representatives
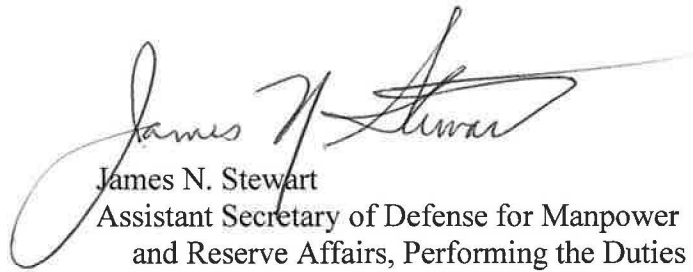Washington, DC 20515

JUL 29 2019

Dear Mr. Chairman:

The enclosed report is in response to Senate Report 115–290, page 212, to accompany
S. 3159, the Department of Defense (DoD) Appropriations Bill, 2019, detailing the scope and
impact of respiratory illness on military personnel—particularly on deployed troops—dating
from the first Gulf War to the present.

The report provides a detailed review of respiratory illness experienced by military
personnel. The Department of Veterans Affairs and DoD have completed, and continue to be
involved in, a number of health studies associated with respiratory exposures. Epidemiological
studies, with and without associated clinical studies, have been conducted and include various
timeframes from 2001 to the present, to evaluate potential respiratory diseases associated with
historical exposures.

Thank you for your interest in the health and well-being of our Service members,
veterans, and their families. A similar letter is being sent to the other congressional defense
committees.

James N. Stewart
Assistant Secretary of Defense for Manpower
    and Reserve Affairs, Performing the Duties
    of the Under Secretary of Defense for
    Personnel and Readiness

Enclosure:
As stated

cc:
The Honorable Ken Calvert
Ranking Member

Report to Congressional Defense Committees

July 2019

Senate Report 115-290, page 212, to accompany S. 3159, the Department of Defense Appropriations Bill, 2019, "Warfighter Respiratory Health"

I. Congressional Reporting Request

This report is in response to Senate Report 115–290, page 212, to accompany S. 3159, the Department of Defense (DoD) Appropriations Bill, 2019, that requests the Assistant Secretary of Defense for Health Affairs to provide a report to the congressional defense committees detailing the scope and impact of respiratory illness on military personnel – particularly on deployed troops – dating from the first Gulf War to the present.

II. Scope and Impact of Respiratory Illness in Service Members

Executive Summary

The scope of respiratory illnesses among military personnel is measurable by subjective surveys and objective methods such as epidemiology, research, and health surveillance of health care encounters and outcomes associated with respiratory symptoms among Service members. The range of respiratory illnesses include both infections and non-infectious conditions of the upper and/or lower respiratory tract. Impacts range from acute illnesses associated with annual influenza and colds that temporarily limit daily activity to more chronic illnesses that could result in hospitalization and, in some cases, a deployment-limiting condition or medical disability and separation from military service.

There are some Service members and veterans with ongoing respiratory symptoms and/or diagnoses of chronic respiratory conditions (asthma and other less common conditions) that may be associated with their deployment to Southwest Asia, U.S. Central Command (USCENTCOM) area of responsibility. The U.S. Armed Forces have had a continual presence in the region since the Iraqi invasion of Kuwait in August 1990. Occupational, environmental, and military unique exposures have been discussed in the literature and span the range of potential and actual exposures expected for the location, activities, and timeframe.

High levels of ambient particulate matter (PM) were identified as a potential threat to respiratory health early in Operation IRAQI FREEDOM (OIF).[1] Sampling conducted by preventive medicine personnel deployed to Southwest Asia typically demonstrated levels of PM above those considered healthy by the U.S. Environmental Protection Agency's National Ambient Air Quality Standards. U.S. sources of fine particles (<2.5 μm) include emissions generated by motor vehicles and coal-fired power plants. Generally, the major contributor to PM in Southwest Asia is resuspension of dust and soil from the desert floor. Open-air burn pits are alternate forms of waste disposal used by the U.S. military to dispose of solid waste. Burn pit emissions contributed to the total amount of pollutants (e.g., fumes, vapors, gases, and PM) to which deployed personnel were exposed. Emissions from burn pits likely varied over time and between locations because of heterogeneity in the trash burned that may have produced variable levels of

---

[1] Desert Research Institute. DoD Enhanced Particulate Matter Surveillance Program. Reno, NV: DRI; 2008. Final Report

PM, metals, volatile organic compounds, and polycyclic aromatic hydrocarbons.[2] Exposures from chemicals associated with ongoing military-related, industrial activities (e.g., petroleum, oil, lubricants, and vehicle exhaust) from both occupational and environmental perspectives also contribute to total airborne exposures to Service members. Thus, individual exposure to burn pit emissions and industrial activities likely varied by personnel activity patterns and their locations relative to the burn pit and industrial areas, as well as meteorological conditions.[3]

This report describes previous and ongoing efforts that address the committee request to "[detail] the scope and impact of respiratory illness on military personnel – particularly on deployed troops – dating from the first Gulf War to the present." In doing so, this report also indicates that ongoing and future activities of the DoD and Department of Veterans Affairs (VA) are in line with the Committee's inclusion of respiratory health as part of the Peer-Reviewed Medical Research Program (PRMRP) and view that further development of a comprehensive, broad-based warfighter respiratory research program is necessary to support overall readiness.

The report begins with an overview of previous, ongoing, and future efforts to evaluate Service member adverse health effects associated with deployment-related environmental exposures (Section II.A.). This is followed by an epidemiology section that describes respiratory-related illnesses from 1990 to present (Section II.B.).

In the Senate Report 115–290 language ("it is estimated that respiratory diseases affect more than 100,000 Service members each year and result in almost 27,000 lost workdays per year") appears to have been cited from part of a paper by Sanchez et al., 2015.[4] The focus of the Sanchez et al. paper was on acute respiratory illnesses in military recruits during their military training, and did not include Service members during or after deployment. Acute respiratory illnesses are largely associated with seasonal influenza and colds, rather than environmental exposures.

Individual Medical Readiness, used to identify deployability of personnel, is generally not impacted by acute respiratory illnesses.[5] That is, while these illnesses may temporarily limit Service member activities, they typically are not deployment-limiting medical conditions that would prevent Service members from deploying after they recovered. Rather, a deployment-limiting condition significantly impairs performance of duties in a deployed environment.[6] In

---

[2] Institute of Medicine. Long-Term Health Consequences of Exposure to Burn Pits in Iraq and Afghanistan. Washington, DC: National Academies Press; 2011
[3] Ciminera P, Baird CP, Eschenbacker W, Harkins DK. Overview of Airborne Hazards in Operation Enduring Freedom, Operation Iraqi Freedom, and Operation New Dawn. Baird CP and Harkins DK, editors. Airborne Hazards Related to Deployment. Fort Sam Houston, Texas: Borden Institute, US Army Medical Department and School; 2015
[4] Sanchez JL, Cooper MJ, Myers CA, Cummings JF, Vest KG, Russell KL, Sanchez JL, Hiser MJ, Gaydos CA. 17 June 2015. Respiratory infections in the U.S. military: recent experience and control. Clin Microbiol Rev doi:10.1128/CMR.00039-14
[5] DoD Instruction 6025.19. Individual Medical Readiness (IMR). June 9, 2014
[6] DoDI 6490.07, Deployment-Limiting Medical Conditions for service members and DoD Civilian Employees, February 5, 2010)

general, Service members with existing medical conditions may deploy based on a medical assessment: a condition may manifest as a deployment-limiting by severity (a worse form of disease that may be acute) or chronicity (long term or indefinite duration). The DoD and Military Department standards for appointment, enlistment, or induction into the military services include abnormal findings of the respiratory system. [7] The disability evaluation system and Military Department retention determinations are used to evaluate whether a medical condition prevents a Service member's ability to perform his/her duties.[8]

A. Overview of Previous, Ongoing, and Future Efforts to Evaluate Health Impacts from Deployment-Related Airborne Exposures: Exposure Assessment, Health and Toxicology

A.1. DoD and VA Activities. The DoD and VA work jointly to review and synchronize research efforts, improve real-time exposure monitoring of deployed forces, communicate information about the Airborne Hazards and Open Burn Pit Registry to Service members and veterans, and best integrate exposure-related information into Service member Individual Longitudinal Exposure Record (ILER; currently under development). These activities are aligned with the PRMRP and incorporate recommendations from the Defense Health Board's (DHB) February 2015 report, "Deployment Pulmonary Health," and elsewhere.

The DHB report focused on: 1) establishing pre-deployment clinical baselines and post-deployment screening for chronic pulmonary symptoms and disease; 2) diagnosis of pulmonary disease; 3) surveillance for deployment-related pulmonary disease; 4) deployment pulmonary health registries; 5) deployment pulmonary health research activities; and 6) prevention of deployment-related pulmonary disease.[9] Also in 2015, a textbook summarizing the state of knowledge by the DoD, VA, and academia on airborne exposures and characterization, population surveillance, health communication and outreach, and research initiatives was published.[10] The DoD and VA will continue to update policies and procedures based on the outcomes of peer-reviewed, published research, and evidence-based practice.

A.2. Institute of Medicine (IOM; currently the National Academy of Medicine). The IOM formed a committee to determine the long-term health effects from exposure to burn pits. The IOM committee published its findings in a report, "Long-Term Health Consequences of Exposure to Burn Pits in Iraq and Afghanistan," in 2011.[11] The IOM concluded that there was inadequate/insufficient evidence of an association between exposure to combustion products and cancer, respiratory disease, circulatory disease, neurologic disease, and adverse reproductive and developmental outcomes in the surrogate populations studied. The IOM also concluded that

---

[7] DoDI 6130.3 Medical Standards for Appointment, Enlistment, or Induction into the Military Services, May 6, 2018, and Military Department Policies

[8] DoDI 1332.18, Disability Evaluation System (DES), August 5, 2014 as amended; DoDI 1332.45 Retention Determinations for Non-Deployable Service Members, July 30, 2018; and Military Department Policies

[9] Defense Health Board. Deployment Pulmonary Health. February 11, 2015 retrieved on June 6, 2019 at https://health.mil/Reference-Center/Reports/2015/02/11/Deployment-Pulmonary-Health

[10] Baird CP and Harkins DK, editors. Airborne Hazards Related to Deployment. Fort Sam Houston, Texas: Borden Institute, US Army Medical Department and School; 2015

[11] US Institute of Medicine. Long-Term Health Consequences of Exposure to Burn Pits in Iraq and Afghanistan. National Academies Press; 2011

there was limited/suggestive evidence of an association between exposure to combustion products and reduced pulmonary function in these populations.

In March 2019, the first meeting of the National Academy of Medicine's Committee on the Respiratory Health Effects of Airborne Hazards Exposures in the Southwest Asia Theater of Military Operations was held. The committee is to "comprehensively review, evaluate, and summarize the available scientific and medical literature regarding the respiratory health effects of exposure to airborne hazards encountered during service in the Southwest Asia theater of military operations". The final report, along with associated conclusions and recommendations are anticipated in December 2020.

A.3. PRMRP Update. The fiscal year (FY) 2018 PRMRP provides funding for research in 52 topic areas, including a topic area specific to open-air burn pit exposure, and to several topic areas potentially related to open-air burn pit exposure, such as acute lung injury, constrictive bronchiolitis, metals toxicology, pulmonary fibrosis, lung injury, and respiratory health. Each year, the DoD publically announces the "Areas of Encouragement" related to the PRMRP research topic areas identified in the DoD Appropriations Act, 2018.

A.4. American Thoracic Society (ATS) Workshop. The ATS held a workshop in May 2018 that included an expert panel of 25 individuals across academia and the U.S. Government. The focus of the workshop was to evaluate potential adverse health effects associated with inhalation exposures during land-based U.S. military deployments to Afghanistan and Southwest Asia. The ATS Workshop Report has been approved for publication in the Annals of the ATS (publication date is to be determined).

A.5. Summary of Ongoing Activities.
Self-reported symptoms and exposures to health hazards are captured in DoD health assessments. The periodic health assessment uses DD Form 3024, which includes questions about asthma, wheezing, shortness of breath, difficulty breathing and other lung problems, as well as tobacco use and smoking history, for all Service members. Both post-deployment health assessment forms include health care provider review of self-reported responses to questions that pertain to the respiratory system (DD Form 2796 and DD Form 2900). Post-deployment health assessments include questions about wheezing, shortness of breath, difficulty breathing (other than asthma), coughing, and the open-ended question "Are you worried about your health because you believe you were exposed to something in the environment while deployed? If yes, please explain."

The DoD began long-term holdings of frozen serum specimens from applicants to military service and in Service members at regular intervals throughout their time in service in 1985. Beginning in 1990, serum collections have been associated with HIV testing (remaining after routine HIV-1 antibody testing) and are collected before and after major deployments.[12] The

---

[12] Rubertone MV, Brundage JF. The Defense Medical Surveillance System and the Department of Defense Serum Repository: Glimpses of the Future of Public Health Surveillance. Am J Public Health. 2002 December; 92(12): 1900–1904.

serum is stored in the DoD serum repository and used to conduct epidemiologic studies and inform health policy. The DoD serum repository includes over 62 million samples from Service members and may serve as a supplemental means to identify chemical compounds associated with combustion product-related environmental exposures.[13]

The DoD is also evaluating additional approaches to evaluate airborne exposures (air samples) and associated doses (bioassays) from refined area sampling and assessment approaches, and integration of individual sampling techniques/technologies. Deployment health assessment data is collected in the Defense Medical Surveillance System (DMSS) for study. Prospective cohort studies (the Millennium Cohort Study)[14] and follow-up of participants enrolled in the Airborne Hazards and Open Burn Pit Registry also may provide additional information regarding the development of deployment-related health conditions.

B. Retrospective Cohort Study, Defense Health Agency, Public Health Division, Armed Forces Health Surveillance Branch (AFHSB)

B.1. Summary

This retrospective cohort study was conducted to determine the scope and impact of respiratory illnesses among Service members. To accomplish this objective, the incidence (new cases) and burden of disease (measure of the impact of disease in terms of out-patient medical encounters and hospitalizations) were evaluated. This was accomplished for 12 acute and chronic respiratory illnesses and diseases[15] among Active Component Service members overall, and then, specifically, among deployed Service members for those serving between 1990 and 2018. Data from the DMSS[16] were used for the study. Medical encounter data from 1990-1997 were limited to hospitalizations only, whereas outpatient (ambulatory) and hospitalization data were available from 1998-2018. Among all Active Component Service members over the 21 year period from 1998-2018, acute upper respiratory infections (AURIs) resulted in the highest number of events (6,798,830) and largest incidence rate (248.02 per 1,000 person-years); however, individuals could have multiple events during follow-up (e.g., same person with multiple AURIs).

---

[13] Perdue CL, Cost AA, Rubertone MV, Lindler LE, Ludwig SL. Description and utilization of the United States department of defense serum repository: a review of published studies, 1985-2012. PLoS One 2015; 10: e0114857

[14] Ryan MA, Smith TC, Smith B, Amoroso P, Boyko EJ, Gray GC, Gackstetter GD, Riddle JR, Wells TS, Gumbs G, Corbeil TE, Hooper TI. Millennium Cohort: enrollment begins a 21-year contribution to understanding the impact of military service. J Clin Epidemiol 2007; 60: 181-191

[15] The twelve acute and chronic respiratory illnesses are acute upper respiratory infections, chronic lower respiratory diseases, bronchitis, chronic bronchitis, emphysema, other chronic obstructive pulmonary diseases, asthma, bronchiectasis, chronic sinusitis, other specified interstitial pulmonary disease, pulmonary eosinophilia, and respiratory symptoms

[16] Defense Medical Surveillance System (DMSS) is a continuously expanding relational database that documents military and medical experiences of service members throughout their careers: https://www.health.mil/Military-Health-Topics/Combat-Support/Armed-Forces-Health-Surveillance-Branch/Data-Management-and-Technical-Support/Defense-Medical-Surveillance-System

For chronic respiratory outcomes that were only counted once during follow-up, chronic lower respiratory diseases, as a whole, had the largest number of cases (210,350) and incidence rate (7.97 per 1,000 person-years), followed by the specific condition of asthma with 130,311 new cases and an incidence rate of 4.85 per 1,000 person-years. The deployed cohort had similar to lower incidence rates compared to the overall Active Component population, which was expected since they were a subset of the overall Active Component population and deployed Service members tend to be "healthier" than the overall Service member population. When compared to the latest annual published data by major disease category affecting Active Component Service members, the 12 respiratory conditions evaluated in this study combined rank behind injury / poisoning, musculoskeletal diseases, and mental health disorders categories based on number of medical encounters and hospital bed days.[17]

The results of this study indicate that acute respiratory conditions affect a large number of Service members, but chronic conditions only affect a little over one percent of the Active Component population. As this was a surveillance study to assess overall rates of each condition, comparisons between cohorts and assessment of risk factors were not conducted and cannot be determined with the data as presented.

B.2. Methods

In addition to the historical and ongoing studies mentioned above, a separate, retrospective cohort study among Active Component Service members serving any time between 1990 and 2018 was conducted to determine the scope and impact of respiratory illness among all Service members and among those who deployed. The scope and impact were measured by using the incidence rate (rate of new cases) and burden of respiratory conditions in this population. The DMSS was used for this study.

The two main objectives of the analysis were to:

1. Calculate the overall and annual incidence rates and burden of specific acute and chronic respiratory conditions among all DoD Active Component Service members.

2. Calculate the overall and annual incidence rates and burden of specific acute and chronic respiratory conditions following at least one deployment (greater than 30-day deployment) for Active Component Service members.

B.2.1. Study Populations

The study population included all Active Component Service members who served at some point between January 1, 1990, and December 31, 2018. Only Active Component Service members were included in the analysis since their medical care is paid for by TRICARE and DMSS has near complete capture of their medical encounter data. Medical care for reserve and guard

---

[17] Absolute and relative morbidity burdens attributable to various illnesses and injuries, non-service member beneficiaries of the Military Health System, 2017. Armed Forces Health Surveillance Branch. MSMR. 2018 May;25(5). Accessed 28 May 2019 at https://health.mil/Reference-Center/Reports/2018/01/01/Medical-Surveillance-Monthly-Report-Volume-25-Number-5

members is typically paid through private insurance, except when they are activated, and therefore is not captured in DMSS. For the deployment-specific analysis, only Active Component Service members who were in service at some point between January 1, 1990 to December 31, 2018, and who had at least one deployment (greater than 30 days deployed) were included in the analysis. Deployment data in DMSS comes from the Defense Manpower Data Center and includes all deployments in support of USCENTCOM and Operation UNITED RELIEF (Haiti). All analyses were stratified into two time periods, 1990-1997 and 1998-2008. This stratification was needed to assess the influence of differential ascertainment of outcomes (respiratory conditions) during the two periods since DMSS contains hospitalization data but not outpatient care data from 1990-1997. In 1998, outpatient care data were added to DMSS, allowing for a more complete capture of the outcomes of interest.

B.2.2. Respiratory Conditions (outcomes of interest)

Data from the DMSS on outpatient care and hospitalizations at military medical treatment facilities (MTFs) or purchased care (medical encounters not occurring at MTFs, but paid for by TRICARE) were used to define the outcomes of interest. Case definitions were based on International Classification of Disease, Clinical Modification (ICD-CM) 9/10[18] codes and standard AFHSB case definitions as listed below:

1. AURI:
   a. ICD-9 codes: 460-466
   b. ICD-10 codes: J00-J06
   c. Case definition: One hospitalization or one ambulatory encounter with an ICD code of interest in the primary diagnostic position. An individual can be counted as an incident new case every 14 days.

2. Chronic Lower Respiratory Disease (CLRD)[19]:
   a. ICD-9 codes: 490-496
   b. ICD-10 codes: J40-J47
   c. Case definition: One hospitalization or two ambulatory encounters within two years of each other (same sub-category as listed below) with an ICD code of interest in any diagnostic position. An individual can be counted as a case once per lifetime.
   d. Specific outcomes within the overarching CLRD category were analyzed separately using the same case definition (ICD-9 / ICD-10):
      i. Bronchitis (490 / J40)
      ii. Chronic bronchitis: (491 / J41-J42)
      iii. Emphysema: (492 / J43)
      iv. Asthma: (493 / J45)
      v. Bronchiectasis: (494 / J47)
      vi. Chronic airway obstructions, not otherwise classified (Other Chronic Obstructive Pulmonary Disease, COPD): (496 / J44)

---

[18] ICD-10 diagnosis codes start date was 1OCT15
[19] Case counts and incidence rates for chronic lower respiratory diseases (CLRD), as a whole, are reported; in addition, counts and rates of the six conditions which are a subset of CLRD are also reported

3. Chronic sinusitis:
   a. ICD-9 codes: 473
   b. ICD-10 codes: J32
   c. Case definition: One hospitalization or two ambulatory encounters occurring within two years of each other with an ICD code of interest in any diagnostic position. An individual can be counted as a case once per lifetime.

4. Other specified interstitial pulmonary diseases including bronchiolitis obliterans organized:
   a. ICD-9 codes: 516.36
   b. ICD-10 codes: J84.89, J84.116
   c. Case definition: One hospitalization or two ambulatory encounters occurring within two years of each other with an ICD code of interest in the primary diagnostic position. An individual can be counted as a case once per lifetime.

5. Pulmonary eosinophilia, not elsewhere classified:
   a. ICD-9 codes: 518.3
   b. ICD-10 codes: J82
   c. Case definition: One hospitalization or two ambulatory encounters occurring within two years of each other with an ICD code of interest in the primary diagnostic position. An individual can be counted as a case once per lifetime.

6. Respiratory symptoms (includes codes for shortness of breath, wheezing, and cough):
   a. ICD-9 codes: 786.05, 786.07, 786.2
   b. ICD-10 codes: R06.02, R06.2, R05
   c. Case definition: One hospitalization or one ambulatory encounter with an ICD code of interest in the primary diagnostic position. An individual can be counted as an incident new case every 14 days.

For the outcomes that only count an individual as a case once per lifetime, individuals were excluded from the study cohort if they had the outcome of interest prior to entering the study cohort.

B.2.3. Analytic Methods

An incident case was defined as a new occurrence of the outcome of interest. When the lifetime incidence rule was applied, as with 10 of the 12 outcomes for this study, an individual was only counted as an incident case of the outcome of interest once during the study. An incidence rate was defined as the number of new cases during the follow-up period of the study divided by the sum of follow-up time for all individuals in the cohort. The amount of time (number of days or years) an individual was followed-up for the condition of interest is referred to as person-time. Person-time was calculated as the number of years from the date the individual entered the study cohort (entry into military for the overall analysis and first day after returning from his/her first deployment for the deployment-specific analysis) to the end of his/her follow-up. Person-time was then divided by 1,000 to produce incidence rates per 1,000 person-years. The incident rate can then be interpreted as the number of new cases observed for every 1,000 persons per year.

The end of follow-up and accrual of person-time occurred when the individual had the outcome of interest (chronic conditions only), moved to a non-Active Component (loss of complete capture of medical encounters), left military service (can no longer capture medical encounters), or the end of the surveillance period (December 31, 1997, for the 1990-1997 cohorts and December 31, 2018, for the 1998-2018 cohorts). Additionally, for the deployed cohorts, individuals were only followed-up for a maximum of 10 years after the end of their first deployment. This was done in order to more temporally associate the outcomes with the deployment.

The crude incidence rates were calculated for each condition within each cohort. Rates were calculated for each condition overall and then stratified by year, service (time-varying covariate), age category (time-varying covariate), sex, and race/ethnicity. For the deployed cohort, rates were also stratified by total number of deployments and total time deployed by the end of follow-up.

Additionally, to assess the overall burden of each respiratory outcome on the individuals and Military Health System, for all individuals who met the case definition for the outcome of interest, all of their subsequent medical encounters for the outcome of interest were summarized. The average number of encounters annually per person, the average number of encounters overall per year, and the average number of hospitalized days per year were calculated for each outcome among the cases in the 1998-2018 overall Active Component and deployed cohorts.

B.3. Results
B.3.1. Cohort Descriptions

Table 1 displays the demographic characteristics of the 1990-1997 and 1998-2018 overall Active Component cohorts at the time of entering the study (entry into military service or the start of the cohort period; whichever came later). The 1990-1997 cohort consisted of 3,634,491 Service members. The 1998-2018 cohort consisted of 5,086,445 Service members. If a Service member was in service during both time periods, he or she was counted for both cohorts. The majority of the cohorts were male, 17-24 years of age, white race, and were in the Army. Table 2 displays the demographic characteristics of the 1990-1997 and 1998-2018 Active Component deployed cohorts (subsets of the populations in Table 1; demographics at the time of first deployment or start of the cohort period; whichever came later). The 1990-1997 deployed cohort consisted of 674,697 Service members. The 1998-2018 deployed cohort consisted of 2,100,971 Service members. The deployed cohorts had a higher proportion of males and older age groups than the overall Active Component populations.

Table 1. Overall Active Component cohorts: Demographic characteristics

Demographics	1990-1997 Cohort		1998-2018 Cohort	
	N	%	N	%
Total Population	3,634,491	100.00	5,086,445	100.00
Service				
Army	1,278,673	35.18	1,832,455	36.03
Navy	1,023,419	28.16	1,238,214	24.34
Air Force	841,791	23.16	1,069,177	21.02
Marine Corps	455,719	12.54	840,385	16.52
Coast Guard	34,889	0.96	106,214	2.09
Age				
17-24	2,292,657	63.08	3,885,168	76.38
25-29	588,183	16.18	548,836	10.79
30-34	352,509	9.70	296,482	5.83
35-39	237,331	6.53	218,895	4.30
40-44	120,527	3.32	95,447	1.88
45-49	34,541	0.95	31,926	0.63
50-54	7,124	0.20	8,047	0.16
55-59	1,360	0.04	1,250	0.02
60+	259	0.01	394	0.01
Sex				
Female	466,727	12.84	843,907	16.59
Male	3,167,764	87.16	4,242,538	83.41
Race				
Black	678,865	18.68	850,003	16.71
White	2,636,652	72.55	3,597,389	70.73
Other	190,594	5.24	395,005	7.77
Unknown	128,380	3.53	244,048	4.80

Table 2. Deployed cohorts: Demographic characteristics

Demographics	1990-1997 Cohort		1998-2018 Cohort	
	N	%	N	%
Total Population	674,697	100.00	2,100,971	100.00
Service				
Army	294,248	43.61	787,100	37.46
Navy	179,378	26.59	540,718	25.74
Air Force	103,976	15.41	449,704	21.40
Marine Corps	97,089	14.39	320,021	15.23
Coast Guard	6	0.00	3,428	0.16
Age				
17-24	322,399	47.78	1,130,914	53.83
25-29	159,717	23.67	480,744	22.88
30-34	97,561	14.46	236,486	11.26
35-39	62,208	9.22	156,691	7.46
40-44	25,635	3.80	69,342	3.30
45-49	5,962	0.88	21,105	1.00
50-54	1,028	0.15	4,794	0.23
55-59	153	0.02	739	0.04
60+	34	0.01	156	0.01
Sex				
Female	41,828	6.20	250,596	11.93
Male	632,869	93.80	1,850,375	88.07
Race				
Black	147,240	21.82	352,821	16.79
White	464,874	68.90	1,471,893	70.06
Other	37,424	5.55	161,653	7.69
Unknown	25,159	3.73	114,604	5.45
Number of Deployments during follow-up				
1	646,830	95.87	1,368,187	65.12
2	26,510	3.93	537,705	25.59
3	1,308	0.19	142,676	6.79
4	49	0.01	35,783	1.70
5+	0	0.00	16,620	0.79
Cumulative number of years deployed during follow-up				
<1	657,645	97.47	1,578,820	75.15
1-<2	15,806	2.34	445,482	21.20
2-<3	1,128	0.17	66,844	3.18
3-<4	117	0.02	7,682	0.37
4+	1	0.00	2,143	0.10
Location of first deployment				
Bosnia	47,258	7.00	59,947	4.93
Kosovo	0	0.00	39,997	3.29
Persian Gulf War	559,565	82.94	163,067	7.76

Southwest Asia	67,874	10.06	115,577	5.50
Operation ENDURING FREEDOM	0	0.00	532,912	25.37
Operation IRAQI FREEDOM	0	0.00	687,630	32.73
Operation NEW DAWN	0	0.00	125,617	5.98
Operation UNITED RESPONSE	0	0.00	2,156	0.10
Other	0	0.00	15,172	0.72
Unknown	0	0.00	358,894	17.08

B.3.2. Counts and Incidence Rates of Outcomes

There were 12 acute and chronic respiratory conditions evaluated for each cohort which are described in Table 3 and the following figures. Of note, one condition, "Other specified interstitial; pulmonary diseases (bronchiolitis obliterans organized)" is included in Table 3, but is excluded from subsequent tables and figures because it had zero cases among the 1990-1997 cohort and only 39 cases among the 1998-2018 cohort. The cases occurred between 2011 and 2018 (1 case in 2011, 2 cases per year from 2012-2014, 7 cases in 2015, 9 cases in 2016, 6 cases in 2017, and 10 cases in 2018). Less than half, 15 of the 39 total cases, occurred among deployed Service members (1 in 2012, 2014, and 2017, 5 in 2015 and 2018, and 2 in 2016).

B.3.2.1. Overall Active Component Cohorts
B.3.2.1.1. Combined and Annual Incidence Rates

The overall count, person-years, and incidence rate for each condition for the 1990-1997 and 1998-2018 Active Component cohorts are presented in Table 3. Counts were significantly smaller for the 1990-1997 cohort due to only inpatient data being available during this time period. Many of the conditions evaluated here do not typically result in hospital admission, so these results are underestimates of the true case counts and incidence rates for this time period.

AURI had the highest incidence rate compared to the other conditions for the 1990-1997 cohort (0.94 per 1,000 person-years) and the 1998-2018 cohort (248.02 per 1,000 person-years). Nonspecific respiratory symptoms (shortness of breath, wheezing, and cough) had the next highest incidence rate for the 1998-2018 cohort, at 24.28 per 1,000 person-years. The case definition for these outcomes allowed for multiple events per person during the follow-up. Therefore, the case counts and rates are much larger than the chronic conditions which were only counted once per person during the surveillance period. CLRD, asthma, chronic sinusitis, and bronchitis had the next highest incidence rates.

Table 3. Overall Active Component cohorts: Case count, person-years, and incidence rate of each respiratory condition by cohort

Condition	1990-1997 Cohort*			1998-2018 Cohort		
	Cases (N)	Person-Years	Incidence Rate per 1,000 person-years	Cases (N)	Person-Years	Incidence Rate per 1,000 person-years
Acute upper respiratory infections	12,686	13,321,204	0.95	6,798,830	27,412,267	248.02
Chronic lower respiratory diseases	12,418	13,291,387	0.93	210,350	26,377,507	7.97
Bronchitis	4,032	13,309,839	0.30	75,351	26,998,780	2.79
Chronic bronchitis	392	13,320,371	0.03	3,091	27,399,773	0.11
Emphysema	343	13,320,307	0.03	1,605	27,405,552	0.06
Other COPD	494	13,320,307	0.04	4,448	27,397,894	0.16
Asthma	7,653	13,304,540	0.58	130,311	26,864,261	4.85
Bronchiectasis	58	13,321,075	0.00	703	27,409,919	0.03
Chronic sinusitis	11,144	13,290,179	0.84	112,104	26,755,420	4.19
Other specified intersitial pulmonary disease	0	13,321,204	0.00	39	27,412,214	0.00
Pulmonary eosinophilia, NEC	129	13,320,858	0.01	942	27,408,729	0.03
Respiratory symptoms	59	13,321,204	0.00	665,477	27,412,267	24.28

*Only includes hospitalized cases due to a lack of ambulatory care data during this time period.

The annual incidence rates of each condition for the overall Active Component cohorts are presented in Figures 1-3. Conditions were stratified into different figures based on the magnitude of the incidence rates. The two conditions with the highest incidence rates were AURI and nonspecific respiratory symptoms (Figure 1). AURI incidence rates increased from 1998 to a peak rate in 2011 (249.53 per 1,000 person-years) and then generally decreased for the remainder of the surveillance period. Incidence rates for nonspecific respiratory symptoms steadily increased throughout the surveillance period with a peak rate occurring in 2018 (39.14 per 1,000 person-years). CLRD, asthma, bronchitis, and chronic sinusitis had the next highest incidence rates (Figure 2). Annual trends in incidence rates for these four conditions were similar with peak incidence rates occurring in 2008 and 2009. Incidence rates then decreased annually for these conditions for the remainder of the surveillance period. The remaining five conditions had very low incidence rates and various fluctuations in rates over time (Figure 3).

Figure 1. 1998-2018 overall Active Component cohort: Annual incidence rates of Acute Upper Respiratory Infections and Nonspecific Respiratory Symptoms

Figure 2. 1998-2018 overall Active Component cohort: Annual incidence rates of select chronic respiratory conditions

Figure 3. 1998-2018 overall Active Component cohort: Annual incidence rates of select chronic respiratory conditions (incidence rate <1.0 per 1,000 person-years)
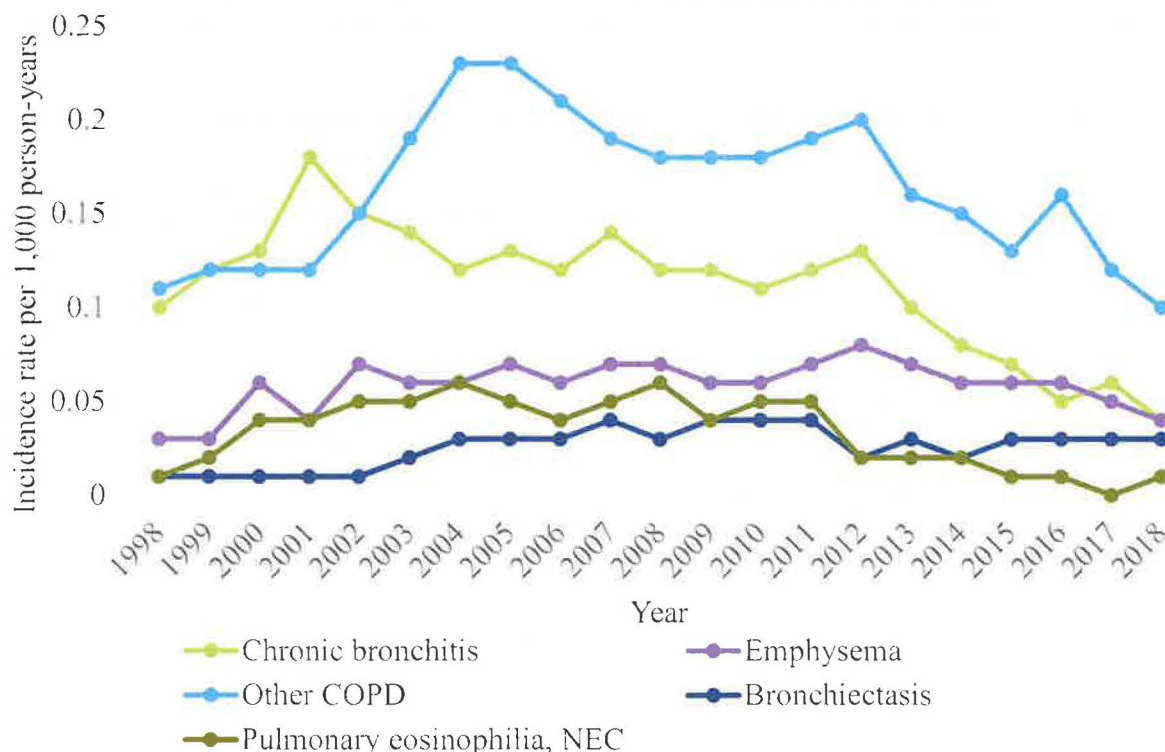
B.3.2.1.2 Incidence Rates by Demographic Characteristics

Incidence rates for each condition among the Active Component 1998-2018 cohort were stratified by service, sex, age category, and race. Due to the different data available from the 1990-1997 cohort described earlier, these data will only be provided in Appendix A and not graphically presented. Incidence rates by age category are presented in Figures 4 and 5. AURI incidence rates were highest in the 17-24 year age group (309.22 per 1,000 person-years) (Figure 4). This is most likely driven by respiratory conditions among recruits in basic training. AURI rates then steadily decreased with age, with the lowest rate being among the 60 years or older category (133.52 per 1,000 person-years).

The age-stratified incidence rates for three of the conditions, CLRD, asthma, and bronchitis, present in a "U-shaped" pattern with the highest rates occurring among 17-24 year olds (10, 5.89, and 3.59 per 1,000 person-years, respectively) and 55-59 year olds (9.79, 5.64, and 3.59 per 1,000 person-years, respectively) and lower rates for the ages in between (Figure 5). For all other respiratory conditions evaluated, the incidence rates increased with age (Figures 4 and 5).

Figure 4. 1998-2018 overall Active Component cohort: Incidence rates of Acute Upper Respiratory Infections and Nonspecific Respiratory Symptoms by age category
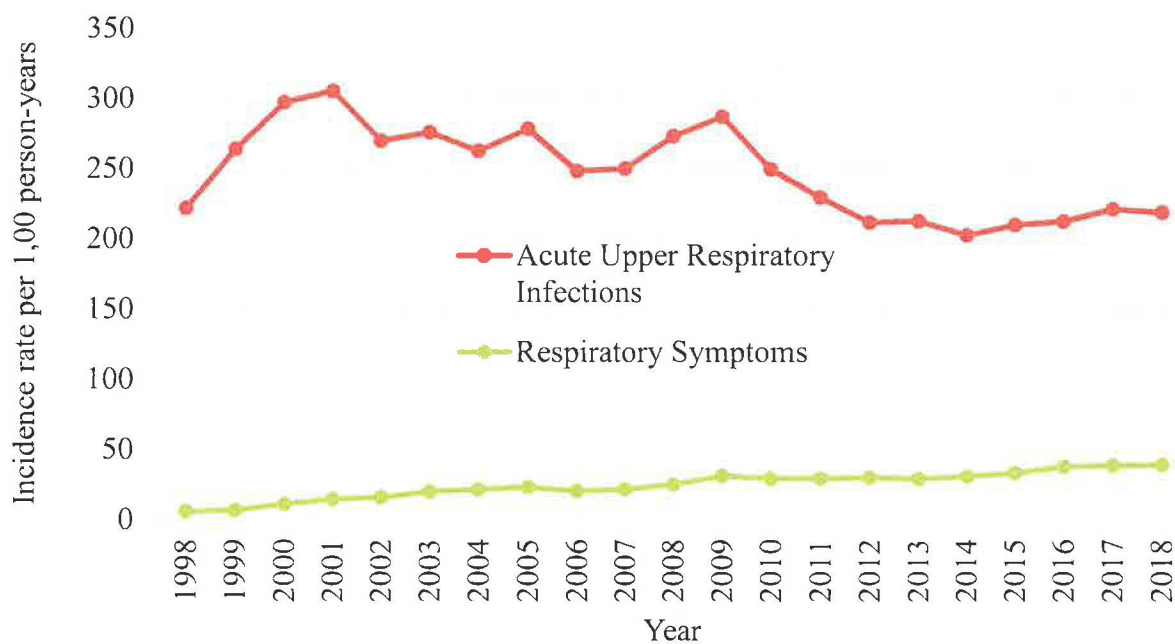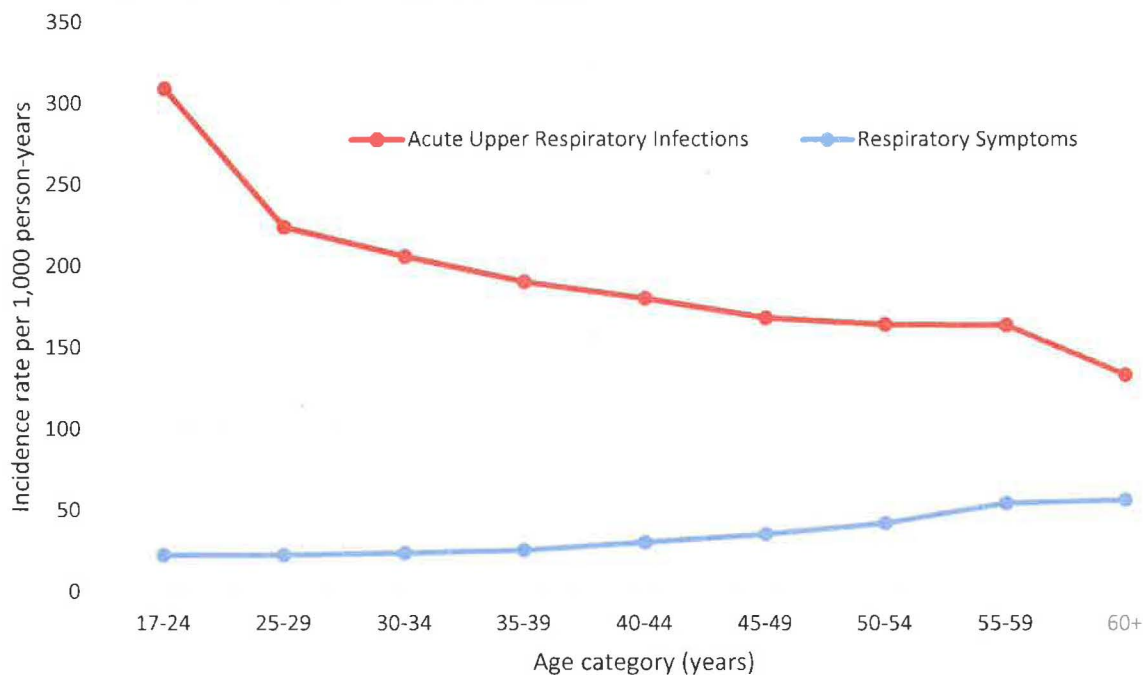

Figure 5. 1998-2018 overall Active Component cohort: Incidence rates of chronic respiratory conditions by age category
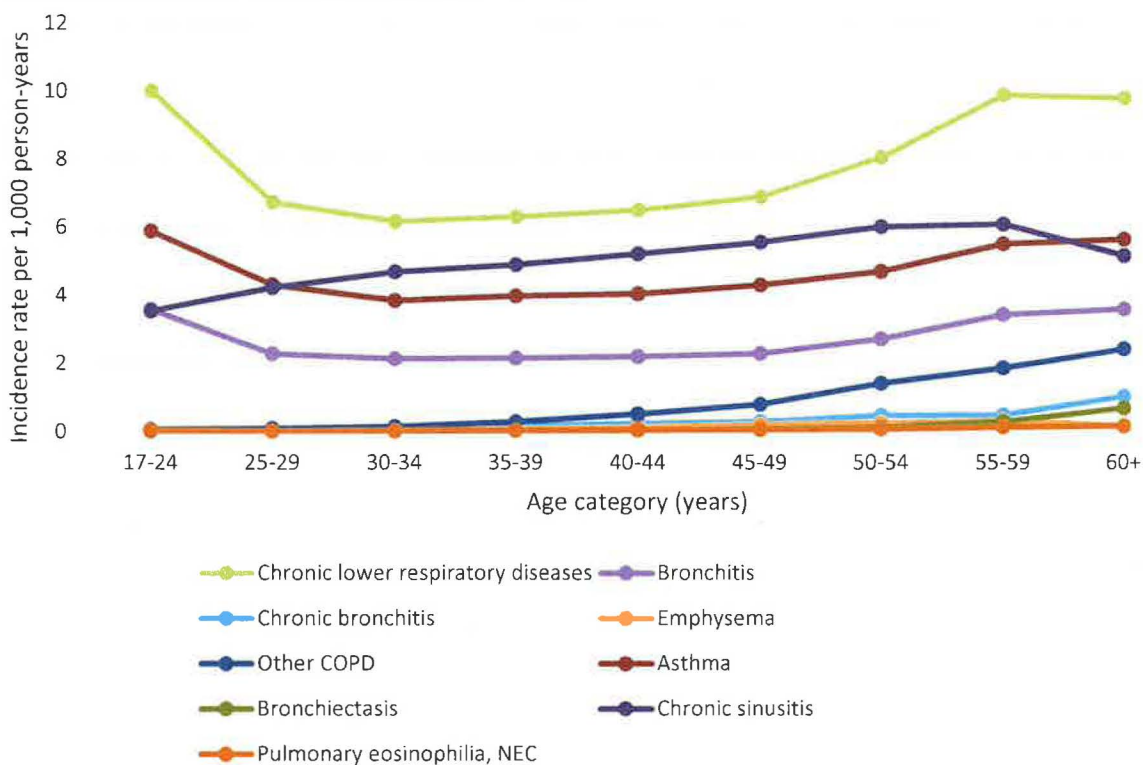
Incidence rates for each condition varied by service (Appendix B). Air Force Service members had the highest incidence rates for AURI (319.37 per 1,000 person-years) and nonspecific respiratory symptoms (31.59 per 1,000 person-years) compared to the other services. Incidence rates were highest among Army Service members for CLRD (10.92 per 1,000 person-years) and Asthma (7.12 per 1,000 person-years). Chronic sinusitis was highest among Coast Guard members (6.63 per 1,000 person-years). All other outcomes had relatively similar incidence rates between the services.

Females had higher incidence rates than males for all conditions except emphysema, other COPD, and pulmonary eosinophilia. Female rates were close to two times higher than males for AURI, CLRD, bronchitis, asthma, chronic sinusitis, and nonspecific respiratory symptoms (Appendix B). Although exact incidence rates varied by race, rates were relatively similar between the races for all conditions except CLRD and asthma. CLRD (9.94 per 1,000 person-years) and asthma (7.21 per 1,000 person-years) incidence rates were highest among black Service members (Appendix B).

B.3.2.2 Deployed Active Component Cohorts
B.3.2.2.1 Combined and Annual Incidence Rates

The overall count, person-years, and incidence rate for each condition for the 1990-1997 and 1998-2018 deployed cohorts are presented in Table 4. As with the overall Active Component population, counts were significantly smaller for the 1990-1997 cohort and AURI (0.44 per 1,000 person-years) and nonspecific respiratory symptoms (24.43 per 1,000 person-years) had the highest incidence rates for the 1998-2018 cohort. CLRD, asthma, chronic sinusitis, and bronchitis had the next highest incidence rates for the 1998-2018 cohort (6.05, 4.04, 3.97, and 1.96 per 1,000 person-years, respectively).

Compared to the overall Active Component population, the deployment cohort incidence rates were consistently the same or lower for all of the outcomes except "Other COPD." This lower rate of disease among deployed Service members was expected due to a well-recognized phenomenon called the "healthy deployer effect." The incidence rate of other COPD was still very close at 0.19 per 1,000 person-years among the deployed cohort and 0.16 per 1,000 person-years among the overall Active Component population.

Table 4. Deployed cohorts: Case count, person-years, and incidence rates of each respiratory outcome by cohort

Condition	1990-1997 Cohort*			1998-2018 Cohort		
	Cases (N)	Person-Years	Incidence Rate per 1,000 person-years	Cases (N)	Person-Years	Incidence Rate per 1,000 person-years
Acute upper respiratory infections	1,129	2,093,907	0.54	1,625,327	9,021,817	180.16
Chronic lower respiratory diseases	1,744	2,088,298	0.84	52,087	8,616,061	6.05
Bronchitis	345	2,092,385	0.16	17,381	8,862,340	1.96
Chronic bronchitis	72	2,093,724	0.03	1,010	9,017,244	0.11
Emphysema	71	2,093,695	0.03	552	9,019,089	0.06
Other COPD	109	2,093,704	0.05	1,687	9,016,154	0.19
Asthma	1,234	2,090,244	0.59	35,578	8,803,473	4.04
Bronchiectasis	5	2,093,891	0.00	215	9,020,911	0.02
Chronic sinusitis	1,556	2,088,820	0.74	34,762	8,764,083	3.97
Pulmonary eosinophilia, NEC	28	2,093,814	0.01	280	9,020,324	0.03
Respiratory symptoms	13	2,093,907	0.01	220,419	9,021,817	24.43

*Only includes hospitalized cases due to a lack of ambulatory care data during this time period.

The annual incidence rates of each condition for the deployed cohorts are presented in Figures 6-8. As with the overall Active Component cohorts, conditions were stratified into different figures based on the magnitude of the incidence rates. The peak activity found in 2008 and 2009 for the overall Active Component was not as prominent in the deployed cohort. Incidence rates among the deployed cohort had minimal fluctuations over time; however, incidence rates for CLRD, asthma, bronchitis, and chronic sinusitis all had a similar decrease in rates from 2012 to 2018. The incidence rates among the deployed cohorts were again consistently lower for all conditions compared to the overall Active Component cohorts.

Figure 6. 1998-2018 deployed cohort: Annual incidence rates of Acute Upper Respiratory Infections and Nonspecific Respiratory Symptoms

Figure 7. 1998-2018 deployed cohort: Annual incidence rates of select chronic respiratory conditions
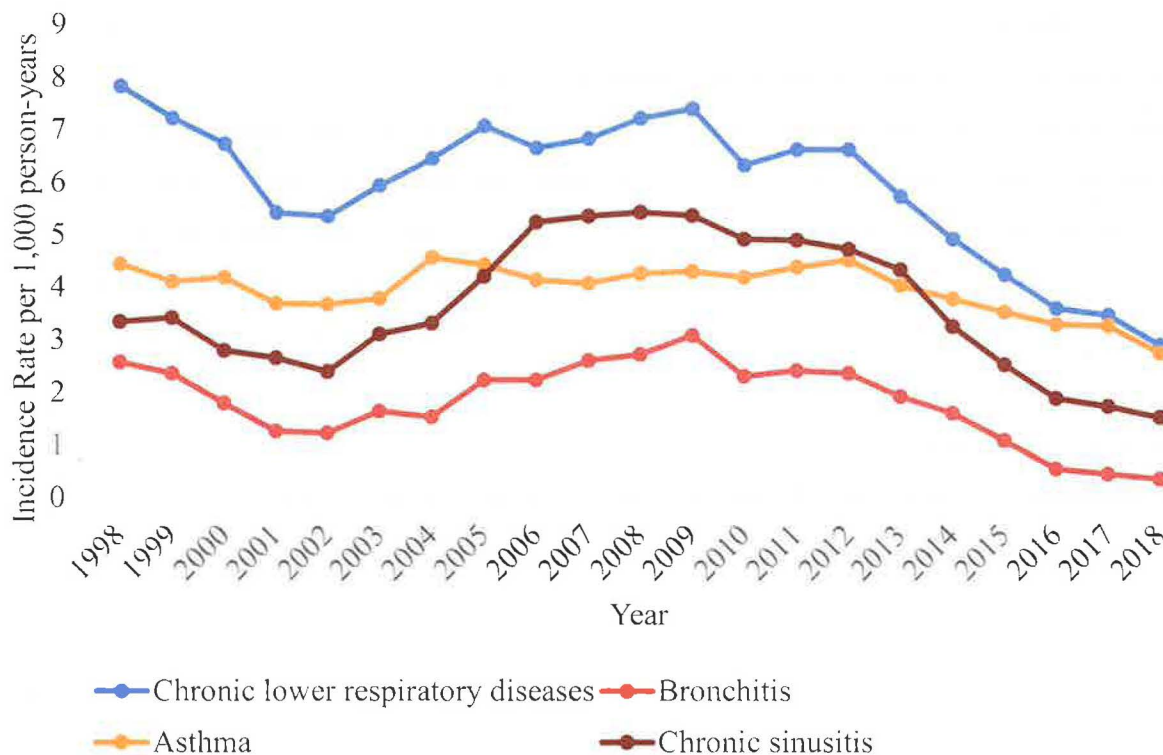
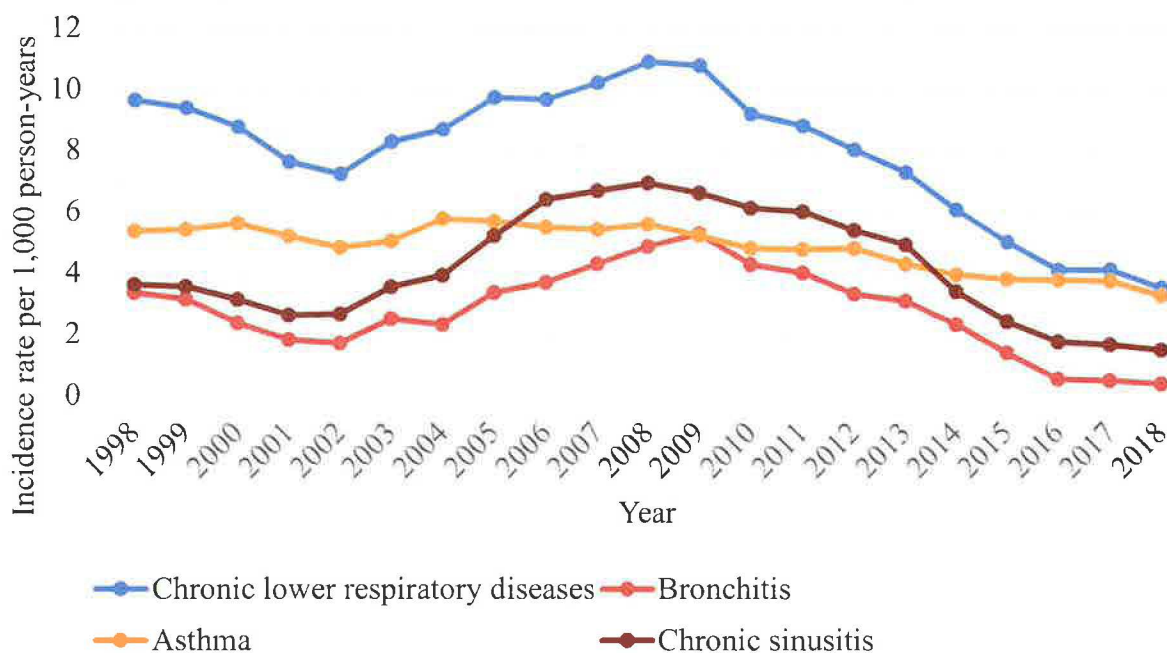**Figure 8. 1998-2018 deployed cohort: Annual incidence rates of select chronic respiratory conditions (incidence rate <1.0 per 1,000 person-years)**
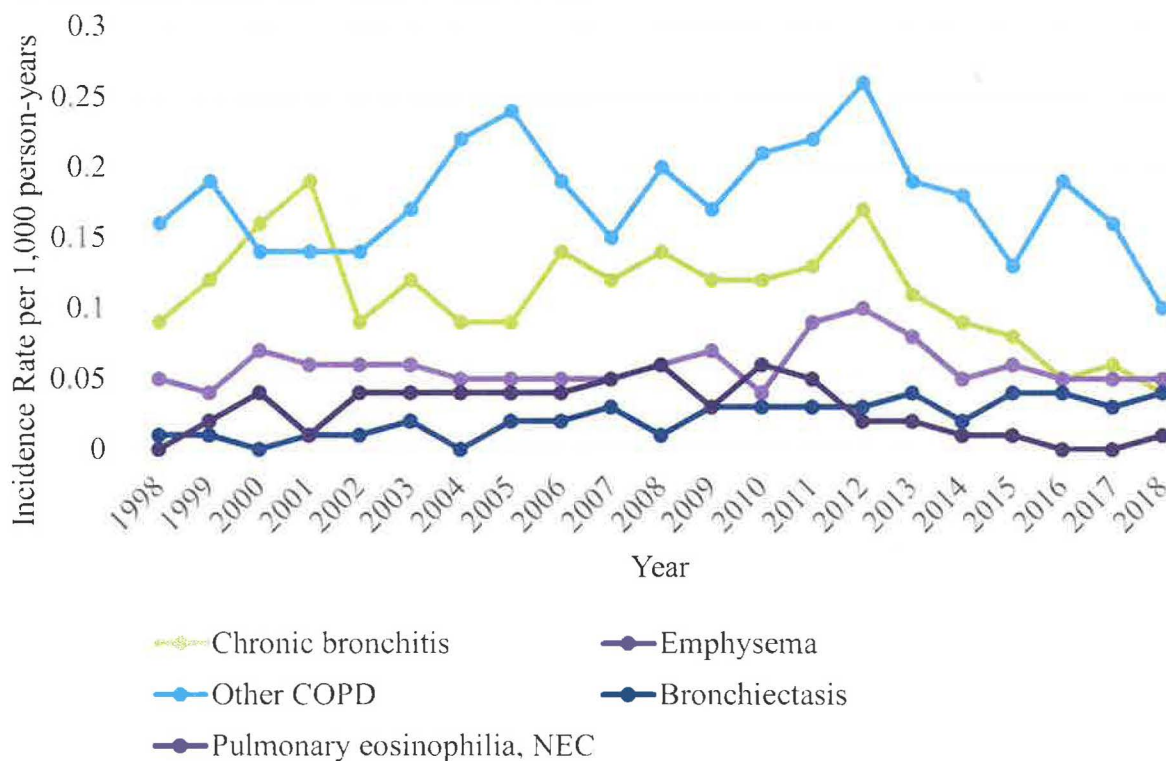
B.3.2.2.2 Incidence Rates by Demographic Characteristics

Incidence rates for each condition among the deployed 1998-2018 cohort were stratified by service, sex, age category, and race. As with the overall Active Component cohort, the 1990-1997 cohort data are only provided in the Appendix C. Incidence rates by age category are presented in Figures 9 and 10. AURI incidence rates were similar to the overall cohort except that they were highest among the 30-34 year age group (189.09 per 1,000 person-years) (Figure 9). The rates then decreased with age, with the lowest rate being among the 60 years or older group (114.19 per 1,000 person-years).

The age-stratified incidence rates for CLRD and asthma also had a similar, although less dramatic, "U-shape" pattern for the 17-24 to 55-59 age groups as the overall Active Component cohort. For these two conditions, the lowest incidence rates (excluding the 60+ age group) were among the 30-34 year olds (5.57 and 3.58 per 1,000 person-years, respectively) and then the rates steadily increased to peak rates among the 55-59 year olds (11.46 and 6.86 per 1,000 person-year, respectively) (Figure 10). For all other respiratory conditions evaluated, the incidence rates increased with age (Figures 9 and 10).

Figure 9. 1998-2018 deployed cohort: Incidence rates of Acute Upper Respiratory Infections and Nonspecific Respiratory Symptoms by age category
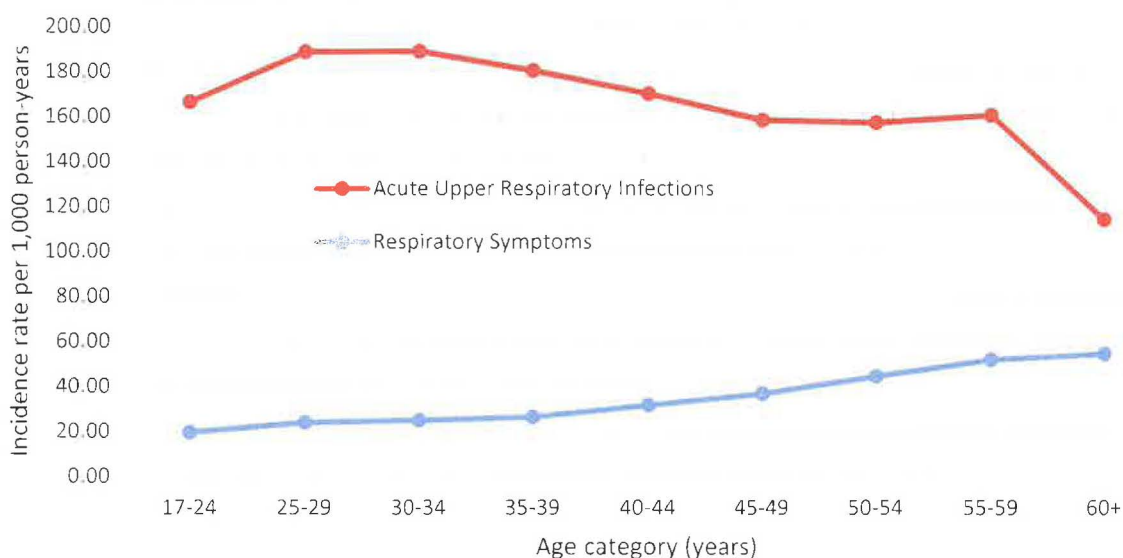
Figure 10. 1998-2018 deployed cohort: Incidence rates of chronic respiratory conditions by age category
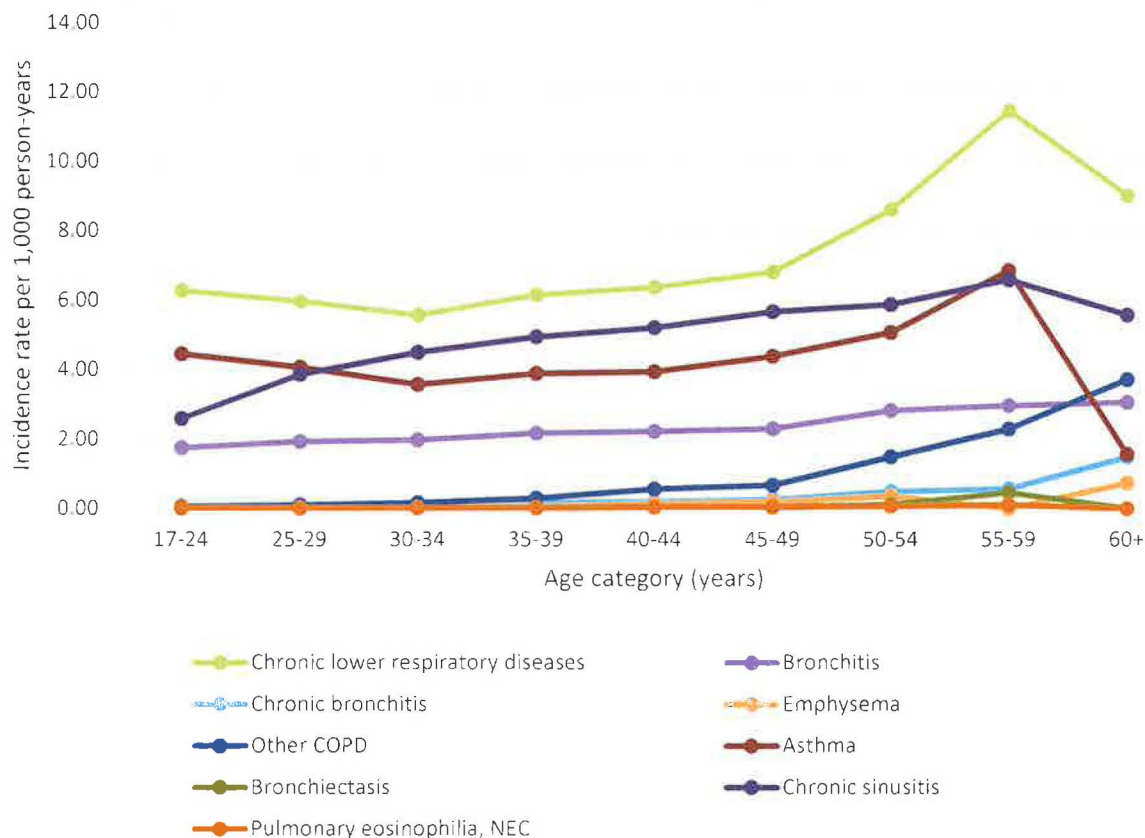
The deployed cohort had similar trends to the overall Active Component cohort with regards to service, sex, and race. Air Force Service members had the highest incidence rates of AURI (268.80 per 1,000 person-years) and nonspecific respiratory symptoms (34.46 per 1,000 person-years). Army Service members had the highest rates of CLRD (7.74 per 1,000 person-years), chronic bronchitis (0.16 per 1,000 person-years), and asthma (5.45 per 1,000 person-years). Chronic sinusitis (6.34 per 1,000 person-years) and bronchitis (2.91 per 1,000 person-years) were highest among Coast Guard members. All other outcomes had relatively similar incidence rates between the services.

Among the deployed cohort, females also had higher incidence rates than males for all conditions except emphysema, other COPD, and pulmonary eosinophilia. Female rates were 1.5 times higher than males for AURI, CLRD, chronic bronchitis, bronchiectasis, and nonspecific respiratory symptoms and two times higher for asthma and chronic sinusitis (Appendix D). As with the overall Active Component cohort, incidence rates were similar between races except for CLRD and asthma. CLRD (7.25 per 1,000 person-years) and asthma (5.60 per 1,000 person-years) incidence rates were highest among black Service members (Appendix D).

For the deployed cohort, incidence rates for each condition were also stratified by the total number of deployments and time deployed at the end of follow-up. Incidence rates for each condition by the total number of deployments are presented in Tables 11 and 12. For all

conditions except AURI, the incidence rate decreased with increased numbers of deployments. Incidence rates for AURI had a "U-shaped" pattern with highest incidence rates among Service members with one or five or more deployments and lower rates among those with two, three, or four total deployments. Incidence rates by total time deployed at the end of follow-up were also evaluated and similar patterns of decreasing incidence rates with increasing total time deployed were seen (Appendix D).

Figure 11. 1998-2018 deployed cohort: Incidence rates of Acute Upper Respiratory Infections and Nonspecific Respiratory Symptoms by total number of deployments
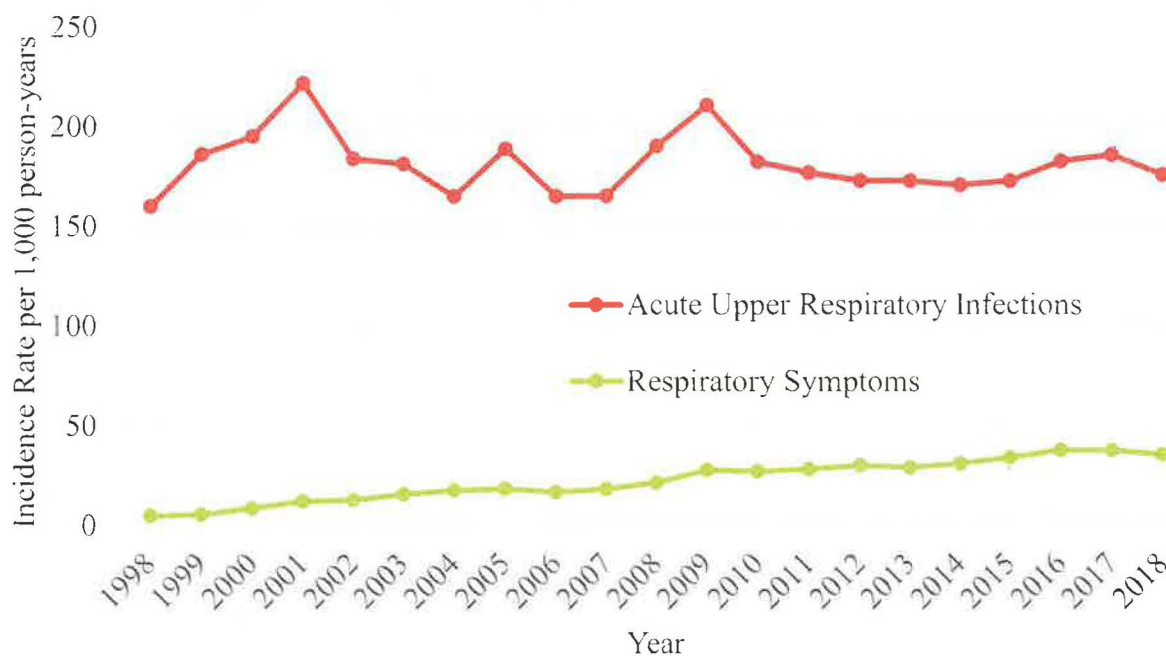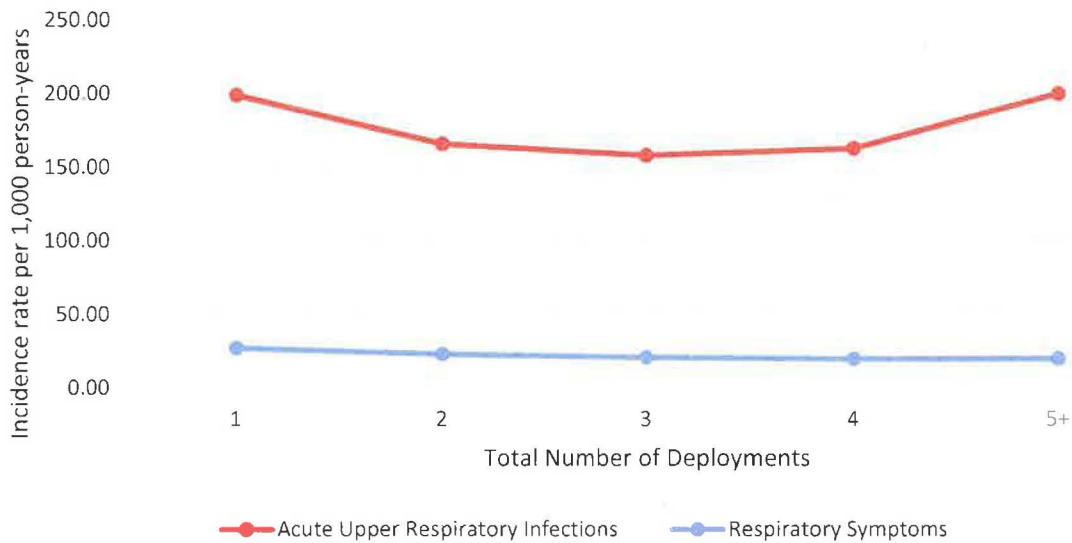
Figure 12. 1998-2018 deployed cohort: Incidence rates of chronic respiratory conditions by total number of deployments
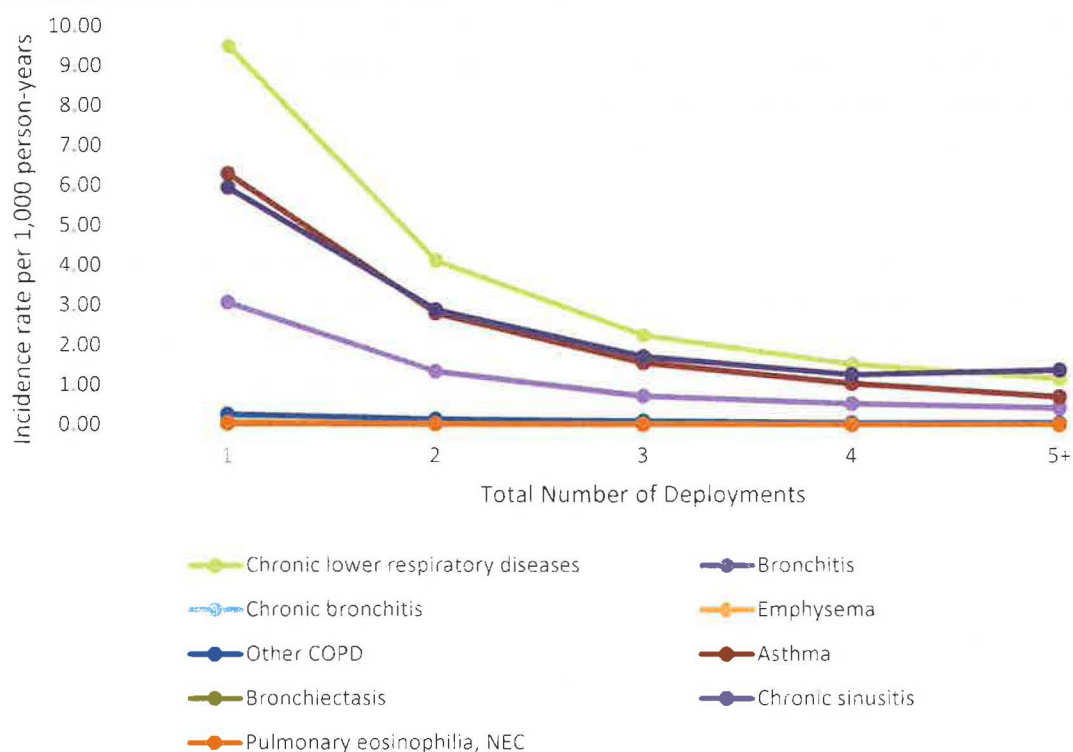
B.3.2.3 Burden of Disease: 1998-2018 Cohorts

Burden of disease is a measure of the impact of disease in terms of out-patient medical encounters and hospitalizations. For individuals who met the case definition for the outcome of interest, all of their subsequent medical encounters for that outcome were summarized to assess burden of (respiratory) disease. The average number of encounters per case, encounters per year, and days hospitalized for each condition among the cases in the overall Active Component and deployed 1998-2018 cohorts are presented in Table 5. Of note, this analysis differed from the previous ones, which counted only the first (incident) visit for the chronic respiratory conditions. Instead, this analysis counted all visits for each disease among the qualifying cases in the cohort. Combined, all of the respiratory conditions evaluated resulted in an average of 549,003 medical encounters a year (sum of average number of encounters per year column). This number, when compared to prior burden of disease reports for Active Component Service members, ranks as the 6th most common cause of medical encounters compared to other large disease categories.[20] The combined respiratory conditions also resulted in a total average number of 15,884 hospitalized days per year for the 1998-2018 Active Component cohort (Table 5). For both cohorts, AURI (multiple cases allowed per Service member during follow-up) resulted in the

---

[20] Absolute and relative morbidity burdens attributable to various illnesses and injuries, non-service member beneficiaries of the Military Health System, 2017. Armed Forces Health Surveillance Branch. MSMR. 2018 May;25(5). Accessed 28 May 2019 at https://health.mil/Reference-Center/Reports/2018/01/01/Medical-Surveillance-Monthly-Report-Volume-25-Number-5

largest number of cases and the highest average number of encounters per year (381,834 overall and 86,414 for the deployed cohort). However, all of the chronic respiratory conditions resulted in a larger average number of encounters annually per case than AURI and nonspecific respiratory symptoms (Table 5). For both cohorts, CLRI resulted in the largest average number of hospitalized days per year, followed by asthma.

Table 5. Burden of Disease: 1998-2018 Overall Active Component and Deployed Cohorts

Condition	Overall active component (1998-2018)				Deployed cohort (1998-2018)			
	Cases (N)	Average number of encounters annually per case	Average number of encounters per year	Average number of hospitalized days per year	Cases (N)	Average number of encounters annually per case	Average number of encounters per year	Average number of hospitalized days per year
Acute upper respiratory infections	6,798,830	1.44	381,834	1,078	1,625,327	1.32	86,414	210
Chronic lower respiratory diseases	210,350	2.60	55,711	6,651	52,087	2.52	12,606	1,642
Bronchitis	75,351	1.74	9,243	534	17,381	1.67	1,980	131
Chronic bronchitis	3,091	2.30	423	125	1,010	2.33	146	46
Emphysema	1,605	2.35	250	291	552	2.56	92	80
Other COPD	4,448	2.41	812	260	1,687	2.29	283	71
Asthma	130,311	2.89	42,801	5,502	35,578	2.81	10,754	1,488
Bronchiectasis	703	3.20	209	45	215	2.93	60	8
Chronic sinusitis	112,104	2.17	21,644	1,301	34,762	2.20	6,058	341
Pulmonary eosinophilia, NEC	942	3.08	160	51	280	3.09	45	11
Respiratory Symptoms	665,477	1.27	35,918	45	220,419	1.28	11,922	16
Combined Conditions	8,003,212	2.32	549,003	15,884	1,989,298	2.27	130,361	4,045

B.4. Discussion

This retrospective surveillance study determined the incidence rates and burden of respiratory conditions among Active Component Service members from 1990-2018. This is the first surveillance study of respiratory conditions among Service members to cover a time period as long as nearly three decades. Although the 1990-1997 time period was limited to hospitalized data only, leading to significantly smaller absolute numbers and rates than the 1998-2018 time period, the impact and trends of the respiratory conditions were similar between the two time periods. Acute outcomes, which could be counted multiple times per Service member, resulted in the highest number of case/events and incidence rates. This was expected as AURI accounts for the largest number of respiratory-associated outpatient medical visits in the general U.S. population.[21] When looking only at the burden of the chronic respiratory conditions combined, this study found that only one percent of the nearly 1.3 million Active Component Service members a year develop new chronic respiratory conditions (Injury/poisoning, musculoskeletal diseases, and mental health disorders accounted for approximately 60 percent of the total disease

---

[21] Centers for Disease Control and Prevention. National Center for Health Statistics. National Ambulatory Medical Care Survey: 2016 National Summary Tables. Accessed on 28 May 2019 at https://www.cdc.gov/nchs/data/ahcd/namcs_summary/2016_namcs_web_tables.pdf

burden for medical encounters and hospital bed days.[22]). So although acute infections are relatively common, as in the general U.S. adult population, chronic respiratory conditions are relatively rare among the Active Component population.

Several patterns in the incidence rates of the respiratory conditions emerged when the data were stratified by demographic characteristics, specifically for age. The incidence of AURI was highest among 17-24 year old Service member and then steadily declined with age. This age group is highly represented by individuals in the recruit setting and is consistent with other findings that indicate recruits have a high rate of respiratory infections during basic training.[23] The "U-shaped" incidence rates of chronic respiratory conditions, when stratified by age category, were similar to findings on asthma prevalence in the general U.S. adult population. The Centers for Disease Control and Prevention reported the highest prevalence rate of asthma within the 15-19 year old age range, a decrease in rate for 20-34 year olds, and then an increase in rate for 35-64 year olds.[24]

Among the deployed cohorts, the results indicate both a temporal association of respiratory conditions during times of peak deployments for OIF and Operation ENDURING FREEDOM and a "healthy-deployer" effect. The "healthy-deployer" effect, a factor where deployed Service members have lower rates of a variety of disease than non-deployed or single deployment Service members simply because they need to be healthy in order to deploy, is also seen in this analysis. Among the deployed cohort in this study, Service members with more than one deployment or longer cumulative time deployed during follow-up had lower rates of the respiratory conditions that Service members with only one deployment or less cumulative time deployed.

Direct comparisons of the rates of these respiratory conditions between the overall Active Component population and the general U.S. population would be difficult to accomplish. The majority of data on the general U.S. adult population is focused on very specific respiratory conditions and/or only provides prevalence rates (number of new and old cases in the current population) instead of incidence rates (new case only) like this study. Asthma was the only condition this study investigated where incidence rates among the general U.S. population were available. A study by Winer et al. used data from the Behavioral Risk Factor Surveillance system from 2006-2008 to generate incidence rates of asthma in adults. That study estimated asthma incidence among "at-risk" adults to be 3.8/1000; whereas the current study found an overall incidence rate of 4.85 per 1,000 person-years among Active Component Service members and 4.04 per 1,000 person-years among previously deployed Active Component

---

[22] Absolute and relative morbidity burdens attributable to various illnesses and injuries, non-service member beneficiaries of the Military Health System, 2017. Armed Forces Health Surveillance Branch. MSMR. 2018 May;25(5). Accessed 28 May 2019 at https://health.mil/Reference-Center/Reports/2018/01/01/Medical-Surveillance-Monthly-Report-Volume-25-Number-5
[23] Sanchez JL, Cooper MJ, Myers CA, Cummings JF, Vest KG, Russell KL, Sanchez JL, Hiser MJ, Gaydos CA. 17 June 2015. Respiratory infections in the U.S. military: recent experience and control. Clin Microbiol Rev doi:10.1128/CMR.00039-14
[24] Centers for Disease Control and Prevention. Data, Statistics, and Surveillance. Most Recent National Asthma Data. Accessed on 28 May 2019 at https://www.cdc.gov/asthma/most_recent_national_asthma_data.htm

Service members. Although the exact rates are slightly higher among Service members, the two studies used very different methods (self-report versus medical encounter data), different time periods, and probable differences in the demographics of the populations.[25]

There are limitations and cautions to be exercised when interpreting the results of this study. This study was designed to be an overall surveillance study to assess the incidence rates and burden of respiratory diseases among Active Component Service members over nearly three decades. The capture of medical encounters varied over this time period, specifically with only the capture of hospitalization between the 1990-1997 time-period. Therefore, comparisons between the annual rates of each condition between the 1990-1997 cohort and the 1998-2018 cohort cannot be made. Additionally, comparisons between the overall cohorts and the deployed cohorts should not be made, as the deployed cohort is a subset of the overall cohort. As designed, this study did not have a valid "non-deployed" comparison group for which to compare the rates among the deployed cohort. Previous studies have been designed to address these comparisons for some of the outcomes. As a surveillance study, the study is descriptive in nature, but does not lend itself to direct comparisons between the cohorts or sub-populations. The case counts and incidence rates are valid for the population they are describing, but in order to appropriately compare these cohorts and sub-populations, additional analyses will need to be conducted that account for difference in the population demographics, exposures, and other risk factors (smoking, obesity, alcohol consumption, etc.).

This study did not include all respiratory diagnostic codes. Specifically, respiratory diagnostic codes associated with known infectious causes (influenza, adenovirus, rhinovirus, etc.) or respiratory cancers were not included. Additionally, acute lower respiratory conditions were not included. The decision to not include these codes was based on expert discussions on the codes that were most relevant to potential service and/or deployment related conditions and conditions that should be identified during military service as opposed to capturing all respiratory conditions, some of which will not be identified until well after leaving service.

This epidemiologic study was able to provide overall surveillance data on the scope and impact of respiratory conditions among Active Component Service member. In conjunction with previously published data on specific time-periods, conditions, and risk-factors for respiratory conditions, a better understanding of respiratory conditions among this population can be determined.

III. **Conclusions**

The DoD and VA will continue to update policies and procedures based on evidence-based practice and the outcomes of peer-reviewed, published research and epidemiologic studies. As indicated in Section II, above, there are a number of DoD and VA deployment health-related activities being worked independently and in concert. In addition, the DoD will continue to utilize available data and resources to develop and refine its Service member health assessments, individual longitudinal exposure records, health studies, and make data available for healthcare providers.

---

[25] Winer RA. Qin X, Harrington T, et al. Asthma incidence among children and adults: findings from the Behavioral Risk Factor Surveillance system asthma call-back survey - United States, 2006-2008. J Asthma. 2012 Feb; 49(1): 16-22

Appendix A: 1990-1997 Active component cohort: Case count, person-years, and incidence rate (per 1,000 person-years) of each respiratory condition by demographic characteristics (only includes hospitalized cases due to a lack of ambulatory care data during this time period)

Variable	Acute Upper Respiratory Infections			Chronic lower respiratory diseases			Bronchitis		
	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate
Total Population	12,686	13,321,204	0.95	12,418	13,291,387	0.93	4,032	13,309,839	0.30
Service									
Army	8,579	4,444,814	1.93	6,992	4,426,476	1.58	2,837	4,436,369	0.64
Navy	1,231	3,852,762	0.32	2,341	3,848,127	0.61	361	3,851,984	0.09
Air Force	2,132	3,555,364	0.60	2,314	3,549,785	0.65	601	3,553,650	0.17
Marine Corps	741	1,436,145	0.52	755	1,434,892	0.53	232	1,435,718	0.16
Coast Guard	3	32,118	0.09	16	32,107	0.50	1	32,118	0.03
Age									
17-24	9,735	5,208,905	1.87	5,551	5,199,043	1.07	2,759	5,202,578	0.53
25-29	1,586	2,904,248	0.55	2,111	2,898,303	0.73	579	2,901,923	0.20
30-34	737	2,303,109	0.32	1,649	2,298,008	0.72	313	2,301,779	0.14
35-39	426	1,745,880	0.24	1,662	1,740,925	0.95	231	1,744,989	0.13
40-44	147	833,537	0.18	939	830,943	1.13	101	833,183	0.12
45-49	44	263,312	0.17	356	262,307	1.36	38	263,212	0.14
50-54	8	51,614	0.15	105	51,345	2.04	9	51,582	0.17
55-59	1	8,581	0.12	32	8,513	3.76	2	8,576	0.23
60+	2	2,017	0.99	13	2,001	6.50	0	2,017	0.00
Sex									
Female	2,791	1,582,878	1.76	3,420	1,575,182	2.17	1,045	1,580,196	0.66
Male	9,895	11,738,326	0.84	8,998	11,716,205	0.77	2,987	11,729,643	0.25
Race									
Black	2,915	2,626,366	1.11	3,218	2,618,092	1.23	815	2,623,946	0.31
White	8,576	9,480,350	0.90	8,186	9,461,556	0.87	2,857	9,472,532	0.30
Other	629	683,638	0.92	656	682,076	0.96	215	683,050	0.31
Unknown	566	530,849	1.07	358	529,664	0.68	145	530,310	0.27

Variable	Chronic bronchitis			Emphysema			Other COPD		
	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate
Total Population	392	13,320,371	0.03	343	13,320,307	0.03	494	13,320,307	0.04
Service									
Army	179	4,444,406	0.04	125	4,444,485	0.03	273	4,444,273	0.06
Navy	106	3,852,564	0.03	127	3,852,432	0.03	97	3,852,610	0.03
Air Force	79	3,555,190	0.02	68	3,555,182	0.02	97	3,555,214	0.03
Marine Corps	27	1,436,094	0.02	23	1,436,091	0.02	27	1,436,092	0.02
Coast Guard	1	32,118	0.03	0	32,118	0.00	0	32,118	0.00
Age									
17-24	122	5,208,732	0.02	96	5,208,719	0.02	40	5,208,830	0.01
25-29	58	2,904,098	0.02	46	2,904,076	0.02	30	2,904,188	0.01
30-34	48	2,302,984	0.02	55	2,302,953	0.02	47	2,303,030	0.02
35-39	81	1,745,702	0.05	71	1,745,695	0.04	101	1,745,666	0.06
40-44	53	833,419	0.06	46	833,421	0.06	131	833,316	0.16
45-49	20	263,243	0.08	20	263,251	0.08	90	263,148	0.34
50-54	9	51,599	0.17	6	51,595	0.12	36	51,558	0.70
55-59	0	8,578	0.00	2	8,580	0.23	15	8,562	1.75
60+	1	2,017	0.50	1	2,016	0.50	4	2,008	0.99
Sex									
Female	97	1,582,691	0.06	25	1,582,826	0.02	59	1,582,788	0.04
Male	295	11,737,680	0.03	318	11,737,481	0.03	435	11,737,519	0.04
Race									
Black	77	2,626,190	0.03	65	2,626,178	0.02	66	2,626,232	0.03
White	280	9,479,785	0.03	260	9,479,700	0.03	409	9,479,620	0.04
Other	22	683,593	0.03	13	683,603	0.02	15	683,610	0.02
Unknown	13	530,803	0.02	5	530,826	0.01	4	530,845	0.01

Variable	Asthma			Bronchiectasis			Chronic sinusitis		
	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate
Total Population	7,653	13,304,540	0.58	58	13,321,075	0.00	11,144	13,290,179	0.84
Service									
Army	3,839	4,435,789	0.87	21	4,444,753	0.00	4,651	4,431,370	1.05
Navy	1,752	3,849,412	0.46	17	3,852,729	0.00	2,350	3,846,472	0.61
Air Force	1,567	3,551,798	0.44	14	3,555,337	0.00	3,491	3,545,647	0.98
Marine Corps	481	1,435,434	0.34	6	1,436,137	0.00	646	1,434,578	0.45
Coast Guard	14	32,108	0.44	0	32,118	0.00	6	32,112	0.19
Age									
17-24	2,716	5,205,591	0.52	14	5,208,889	0.00	3,865	5,200,938	0.74
25-29	1,479	2,900,859	0.51	14	2,904,218	0.00	2,082	2,898,299	0.72
30-34	1,246	2,299,536	0.54	9	2,303,077	0.00	1,968	2,296,821	0.86
35-39	1,255	1,742,234	0.72	9	1,745,849	0.01	1,759	1,739,836	1.01
40-44	661	831,674	0.79	8	833,526	0.01	1,002	830,256	1.21
45-49	220	262,645	0.84	1	263,309	0.00	353	262,145	1.35
50-54	53	51,452	1.03	2	51,610	0.04	90	51,342	1.75
55-59	16	8,538	1.87	1	8,579	0.12	22	8,529	2.58
60+	7	2,011	3.48	0	2,017	0.00	3	2,013	1.49
Sex									
Female	2,354	1,577,880	1.49	9	1,582,859	0.01	2,416	1,576,350	1.53
Male	5,299	11,726,660	0.45	49	11,738,217	0.00	8,728	11,713,829	0.75
Race									
Black	2,339	2,620,703	0.89	15	2,626,345	0.01	1,748	2,621,479	0.67
White	4,708	9,470,828	0.50	39	9,480,249	0.00	8,571	9,456,798	0.91
Other	408	682,746	0.60	3	683,633	0.00	504	682,188	0.74
Unknown	198	530,263	0.37	1	530,848	0.00	321	529,714	0.61

Variable	Pulmonary eosinophilia, NEC			Respiratory Symptoms		
	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate
Total Population	129	13,320,858	0.01	59	13,321,204	0.00
Service						
Army	61	4,444,634	0.01	26	4,444,814	0.01
Navy	24	3,852,719	0.01	11	3,852,762	0.00
Air Force	34	3,555,273	0.01	16	3,555,364	0.00
Marine Corps	10	1,436,114	0.01	6	1,436,145	0.00
Coast Guard	0	32,118	0.00	0	32,118	0.00
Age						
17-24	43	5,208,826	0.01	16	5,208,905	0.00
25-29	23	2,904,188	0.01	11	2,904,248	0.00
30-34	23	2,303,040	0.01	13	2,303,109	0.01
35-39	21	1,745,807	0.01	8	1,745,880	0.00
40-44	12	833,498	0.01	8	833,537	0.01
45-49	4	263,293	0.02	2	263,312	0.01
50-54	2	51,611	0.04	1	51,614	0.02
55-59	1	8,580	0.12	0	8,581	0.00
60+	0	2,017	0.00	0	2,017	0.00
Sex						
Female	16	1,582,843	0.01	12	1,582,878	0.01
Male	113	11,738,015	0.01	47	11,738,326	0.00
Race						
Black	41	2,626,253	0.02	13	2,626,366	0.00
White	76	9,480,146	0.01	35	9,480,350	0.00
Other	7	683,619	0.01	6	683,638	0.01
Unknown	5	530,841	0.01	5	530,849	0.01

Appendix B: 1998-2018 Active component cohort: Case count, person-years, and incidence rate (per 1,000 person-years) of each respiratory condition by demographic characteristics

Variable	Acute Upper Respiratory Infections			Chronic lower respiratory diseases			Bronchitis		
	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate
Total Population	6,798,830	27,412,267	248.02	210,350	26,377,507	7.97	75,351	26,998,780	2.79
Service									
Army	2,211,198	9,032,672	244.80	93,818	8,590,682	10.92	29,956	8,874,626	3.38
Navy	1,498,060	6,956,839	215.34	38,603	6,749,834	5.72	13,800	6,878,007	2.01
Air Force	2,219,626	6,949,994	319.37	46,566	6,698,030	6.95	15,967	6,846,840	2.33
Marine Corps	714,870	3,747,067	190.78	27,057	3,640,638	7.43	13,536	3,686,868	3.67
Coast Guard	155,076	725,695	213.69	4,306	698,322	6.17	2,092	712,438	2.94
Age									
17-24	3,503,777	11,331,157	309.22	110,899	11,094,523	10.00	40,314	11,224,637	3.59
25-29	1,369,071	6,108,279	224.13	39,622	5,886,417	6.73	13,734	6,019,047	2.28
30-34	829,889	4,021,407	206.37	23,603	3,822,404	6.17	8,446	3,944,575	2.14
35-39	625,264	3,279,872	190.64	19,442	3,087,241	6.30	6,922	3,208,636	2.16
40-44	322,692	1,786,586	180.62	10,847	1,669,073	6.50	3,849	1,742,522	2.21
45-49	112,094	664,575	168.67	4,250	616,581	6.89	1,478	646,331	2.29
50-54	29,533	179,620	164.42	1,326	164,676	8.05	473	173,944	2.72
55-59	5,732	34,944	164.03	310	31,383	9.88	115	33,513	3.43
60+	778	5,827	133.52	51	5,211	9.79	20	5,575	3.59
Sex									
Female	1,725,827	4,081,769	422.81	56,566	3,810,637	14.84	18,568	3,984,368	4.66
Male	5,073,003	23,330,498	217.44	153,784	22,566,870	6.81	56,783	23,014,412	2.47
Race									
Black	1,154,877	4,777,628	241.73	45,138	4,541,272	9.94	11,853	4,710,841	2.52
White	4,733,368	18,848,121	251.13	139,365	18,191,926	7.66	54,238	18,557,652	2.92
Other	521,000	2,153,010	241.99	14,304	2,082,423	6.87	5,428	2,122,961	2.56
Unknown	389,585	1,633,509	238.50	11,543	1,561,886	7.39	3,832	1,607,326	2.38

Variable	Chronic bronchitis			Emphysema			Other COPD		
	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate
Total Population	3,091	27,399,773	0.11	1,605	27,405,552	0.06	4,448	27,397,894	0.16
Service									
Army	1,324	9,027,372	0.15	604	9,030,534	0.07	1,719	9,027,691	0.19
Navy	602	6,954,421	0.09	440	6,954,943	0.06	971	6,953,703	0.14
Air Force	685	6,947,150	0.10	335	6,948,189	0.05	1,401	6,944,918	0.20
Marine Corps	296	3,746,081	0.08	176	3,746,392	0.05	221	3,746,391	0.06
Coast Guard	184	724,750	0.25	50	725,493	0.07	136	725,191	0.19
Age									
17-24	879	11,329,535	0.08	551	11,330,090	0.05	558	11,330,331	0.05
25-29	485	6,106,357	0.08	243	6,107,099	0.04	542	6,106,749	0.09
30-34	468	4,019,111	0.12	213	4,020,157	0.05	613	4,019,071	0.15
35-39	559	3,276,917	0.17	195	3,278,492	0.06	951	3,276,298	0.29
40-44	403	1,784,412	0.23	216	1,785,609	0.12	925	1,783,434	0.52
45-49	190	663,558	0.29	130	663,991	0.20	527	662,712	0.80
50-54	84	179,250	0.47	45	179,394	0.25	253	178,816	1.41
55-59	17	34,832	0.49	11	34,902	0.32	65	34,699	1.87
60+	6	5,802	1.03	1	5,818	0.17	14	5,783	2.42
Sex									
Female	639	4,079,067	0.16	139	4,081,286	0.03	644	4,079,714	0.16
Male	2,452	23,320,706	0.11	1,466	23,324,266	0.06	3,804	23,318,180	0.16
Race									
Black	460	4,775,606	0.10	188	4,776,805	0.04	668	4,775,358	0.14
White	2,270	18,839,328	0.12	1,242	18,842,966	0.07	3,382	18,837,464	0.18
Other	186	2,152,280	0.09	108	2,152,505	0.05	171	2,152,388	0.08
Unknown	175	1,632,559	0.11	67	1,633,275	0.04	227	1,632,685	0.14

Variable	Asthma			Bronchiectasis			Chronic sinusitis		
	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate
Total Population	130,311	26,864,261	4.85	703	27,409,919	0.03	112,104	26,755,420	4.19
Service									
Army	62,516	8,775,997	7.12	228	9,031,927	0.03	39,079	8,818,906	4.43
Navy	23,443	6,843,046	3.43	122	6,956,296	0.02	21,261	6,833,986	3.11
Air Force	29,571	6,823,444	4.33	167	6,949,365	0.02	37,636	6,702,584	5.62
Marine Corps	12,824	3,707,757	3.46	170	3,746,690	0.05	9,513	3,703,926	2.57
Coast Guard	1,957	714,017	2.74	16	725,641	0.02	4,615	696,018	6.63
Age									
17-24	66,071	11,219,163	5.89	242	11,330,764	0.02	39,753	11,239,146	3.54
25-29	25,810	5,991,260	4.31	99	6,107,940	0.02	25,278	5,980,032	4.23
30-34	15,082	3,912,705	3.85	91	4,021,021	0.02	18,184	3,880,529	4.69
35-39	12,620	3,171,089	3.98	109	3,279,384	0.03	15,365	3,134,126	4.90
40-44	6,966	1,721,264	4.05	73	1,786,219	0.04	8,825	1,692,068	5.22
45-49	2,743	638,593	4.30	53	664,373	0.08	3,470	624,579	5.56
50-54	806	171,651	4.70	22	179,516	0.12	1,005	167,333	6.01
55-59	182	33,040	5.51	10	34,890	0.29	196	32,184	6.09
60+	31	5,498	5.64	4	5,811	0.69	28	5,421	5.16
Sex									
Female	38,420	3,919,186	9.80	125	4,081,341	0.03	31,715	3,896,817	8.14
Male	91,891	22,945,075	4.00	578	23,328,578	0.02	80,389	22,858,603	3.52
Race									
Black	33,294	4,618,831	7.21	125	4,777,186	0.03	17,453	4,675,543	3.73
White	80,803	18,535,691	4.36	490	18,846,480	0.03	81,210	18,374,026	4.42
Other	8,676	2,117,214	4.10	49	2,152,870	0.02	7,139	2,114,124	3.38
Unknown	7,538	1,592,524	4.73	39	1,633,383	0.02	6,302	1,591,727	3.96

Variable	Pulmonary eosinophilia, NEC			Respiratory Symptoms		
	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate
Total Population	942	27,408,729	0.03	665,477	27,412,267	24.28
Service						
Army	374	9,031,265	0.04	249,213	9,032,672	27.59
Navy	193	6,956,126	0.03	116,030	6,956,839	16.68
Air Force	203	6,949,155	0.03	219,550	6,949,994	31.59
Marine Corps	142	3,746,618	0.04	61,812	3,747,067	16.50
Coast Guard	30	725,565	0.04	18,872	725,695	26.01
Age						
17-24	423	11,330,395	0.04	256,127	11,331,157	22.60
25-29	152	6,107,594	0.02	139,891	6,108,279	22.90
30-34	112	4,020,778	0.03	96,227	4,021,407	23.93
35-39	107	3,279,217	0.03	84,788	3,279,872	25.85
40-44	87	1,786,116	0.05	54,961	1,786,586	30.76
45-49	41	664,352	0.06	23,649	664,575	35.59
50-54	14	179,545	0.08	7,594	179,620	42.28
55-59	5	34,925	0.14	1,910	34,944	54.66
60+	1	5,807	0.17	330	5,827	56.64
Sex						
Female	123	4,081,303	0.03	163,130	4,081,769	39.97
Male	819	23,327,426	0.04	502,347	23,330,498	21.53
Race						
Black	168	4,776,871	0.04	125,351	4,777,628	26.24
White	657	18,845,732	0.03	446,441	18,848,121	23.69
Other	59	2,152,830	0.03	55,726	2,153,010	25.88
Unknown	58	1,633,296	0.04	37,959	1,633,509	23.24

Appendix C: 1990-1997 Deployed cohort: Case count, person-years, and incidence rate (per 1,000 person-years) of each respiratory condition by demographic characteristics (only includes hospitalized cases due to a lack of ambulatory care data during this time period)

Variable	Acute Upper Respiratory Infections			Chronic lower respiratory diseases			Bronchitis		
	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate
Total Population	1,129	2,093,907	0.54	1,744	2,088,298	0.84	345	2,092,385	0.16
Service									
Army	743	905,309	0.82	1,099	901,451	1.22	228	904,166	0.25
Navy	165	593,645	0.28	335	592,796	0.57	46	593,517	0.08
Air Force	124	323,270	0.38	181	322,680	0.56	47	323,080	0.15
Marine Corps	97	271,522	0.36	129	271,210	0.48	24	271,461	0.09
Coast Guard	0	161	0	0	161	0	0	161	0
Age									
17-24	566	518,909	1.09	382	517,964	0.74	116	518,434	0.22
25-29	273	564,850	0.48	433	563,420	0.77	100	564,373	0.18
30-34	167	480,898	0.35	335	479,579	1	44	480,646	0.09
35-39	79	339,045	0.23	318	337,942	0.94	41	338,875	0.12
40-44	30	141,605	0.21	178	141,083	1.26	29	141,496	0
45-49	12	40,568	0	74	40,337	1.83	13	40,537	0.32
50-54	2	6,785	0.29	21	6,735	3.12	2	6,777	0
55-59	0	982	0	1	974	1.03	0	982	0
60+	0	265	0	2	263	7.59	0	265	0
Sex									
Female	120	125,954	0.95	268	125,008	2.14	52	125,676	0.41
Male	1,009	1,967,953	0.51	1,476	1,963,290	0.75	293	1,966,709	0.15
Race									
Black	322	493,960	0.65	550	492,085	1.12	91	493,554	0.18
White	702	1,387,528	0.51	1,043	1,384,383	0.75	231	1,386,542	0.17
Other	51	119,784	0.43	105	119,427	0.88	18	119,713	0.15
Unknown	54	92,635	0.58	46	92,403	1	5	92,576	0.05
Number of Deployments during follow-up									
1	1,076	1,944,522	0.55	1,725	1,939,263	0.89	341	1,943,102	0.18
2	52	141,319	0.37	19	140,979	0.13	4	141,220	0.03
3	1	7,758	0.13	0	7,749	0	0	7,755	0
4	0	307	0	0	307	0	0	307	0
5+	0	0	0	0	0	0	0	0	0
Cumulative number of years deployed during follow-up									
<1	1,099	2,030,573	0.54	1,731	2,025,091	0.85	341	2,029,082	0.17
1-<2	28	58,527	0.48	13	58,401	0.22	4	58,498	0.07
2-<3	2	4,252	0.47	0	4,251	0	0	4,251	0
3-<4	0	548	0	0	548	0	0	548	0
4+	0	6	0	0	6	0	0	6	0

Variable	Chronic bronchitis			Emphysema			Other COPD		
	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate
Total Population	72	2,093,724	0.03	71	2,093,695	0.03	109	2,093,704	0.05
Service									
Army	39	905,205	0.04	32	905,223	0.04	63	905,182	0.07
Navy	24	593,590	0.04	25	593,551	0.04	29	593,600	0.05
Air Force	5	323,252	0.02	7	323,253	0.02	7	323,262	0.02
Marine Corps	4	271,515	0.01	7	271,508	0.03	10	271,500	0.04
Coast Guard	0	161	0	0	161	0	0	161	0
Age									
17-24	8	518,895	0.02	13	518,876	0.03	5	518,902	0.01
25-29	15	564,816	0.03	12	564,806	0.02	4	564,838	0.01
30-34	10	480,855	0.02	18	480,855	0.04	14	480,873	0.03
35-39	22	338,995	0.06	11	338,998	0.03	27	338,988	0.08
40-44	8	141,589	0.06	11	141,577	0.08	30	141,563	0.21
45-49	6	40,546	0.15	5	40,552	0.12	19	40,529	0.47
50-54	3	6,782	0.44	1	6,784	0.15	9	6,766	1.33
55-59	0	981	0	0	982	0	1	980	1.02
60+	0	265	0	0	265	0	0	265	0
Sex									
Female	9	125,937	0.07	6	125,939	0.05	6	125,943	0.05
Male	63	1,967,787	0.03	65	1,967,757	0.03	103	1,967,762	0.05
Race									
Black	14	493,913	0.03	18	493,904	0.04	10	493,939	0.02
White	53	1,387,406	0.04	47	1,387,398	0.03	92	1,387,360	0.07
Other	3	119,779	0.03	3	119,773	0.03	7	119,771	0.06
Unknown	2	92,626	0.02	3	92,620	0.03	0	92,635	0
Number of Deployments during follow-up									
1	72	1,944,360	0.04	69	1,944,349	0.04	106	1,944,335	0.05
2	0	141,298	0	2	141,288	0.01	3	141,304	0.02
3	0	7,758	0	0	7,751	0	0	7,758	0
4	0	307	0	0	307	0	0	307	0
5+	0	0	0	0	0	0	0	0	0
Cumulative number of years deployed during follow-up									
<1	71	2,030,391	0.03	69	2,030,369	0.03	108	2,030,384	0.05
1-<2	1	58,526	0.02	2	58,519	0.03	1	58,513	0.02
2-<3	0	4,252	0	0	4,252	0	0	4,252	0
3-<4	0	548	0	0	548	0	0	548	0
4+	0	6	0	0	6	0	0	6	0

Variable	Asthma			Bronchiectasis			Chronic sinusitis		
	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate
Total Population	1,234	2,090,244	0.59	5	2,093,891	0	1,556	2,088,820	0.74
Service									
Army	788	902,814	0.87	2	905,299	0	697	902,857	0.77
Navy	234	593,071	0.39	1	593,641	0	430	592,408	0.73
Air Force	124	322,887	0.38	1	323,269	0	287	322,264	0.89
Marine Corps	88	271,311	0.32	1	271,521	0	142	271,129	0.52
Coast Guard	0	161	0	0	161	0	0	161	0
Age									
17-24	256	518,470	0.49	1	518,908	0	255	518,277	0.49
25-29	320	563,961	0.57	3	564,847	0.01	377	563,726	0.67
30-34	263	479,900	0.55	0	480,892	0	350	479,647	0.73
35-39	234	338,229	0.69	0	339,041	0	331	337,892	0.98
40-44	110	141,251	0.78	0	141,603	0	173	140,973	1.23
45-49	41	40,431	1.01	0	40,568	0	55	40,337	1.36
50-54	8	6,760	1.18	0	6,785	0	12	6,730	1.78
55-59	0	979	0	1	982	1.02	3	973	3.08
60+	2	263	7.59	0	265	0	0	265	0
Sex									
Female	213	125,285	2	0	125,954	0	152	125,377	1.21
Male	1,021	1,964,959	0.52	5	1,967,937	0	1,404	1,963,442	0.72
Race									
Black	439	492,561	0.89	1	493,956	0	282	493,039	0.57
White	680	1,385,677	0.49	4	1,387,517	0	1,151	1,383,829	0.83
Other	77	119,523	0.64	0	119,784	0	66	119,537	0.55
Unknown	38	92,482	0.41	0	92,635	0	57	92,416	0.62
Number of Deployments during follow-up									
1	1,223	1,941,050	0.63	4	1,944,514	0	1,547	1,939,978	1
2	11	141,128	0.08	1	141,311	0.01	9	140,806	0.06
3	0	7,758	0	0	7,758	0	0	7,728	0
4	0	307	0	0	307	0	0	307	0
5+	0	0	0	0	0	0	0	0	0
Cumulative number of years deployed during follow-up									
<1	1,227	2,026,985	0.61	5	2,030,557	0	1,535	2,025,687	0.76
1-<2	7	58,452	0.12	0	58,527	0	21	58,335	0.36
2-<3	0	4,252	0	0	4,252	0	0	4,243	0
3-<4	0	548	0	0	548	0	0	548	0
4+	0	6	0	0	6	0	0	6	0

Variable	Pulmonary eosinophilia, NEC			Respiratory Symptoms		
	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate
Total Population	28	2,093,814	0.01	13	2,093,907	0.01
Service						
Army	17	905,254	0.02	7	905,309	0.01
Navy	5	593,635	0.01	1	593,645	0 (0
Air Force	4	323,257	0.01	2	323,270	0.01
Marine Corps	2	271,507	0.01	3	271,522	0.01
Coast Guard	0	161	0	0	161	0
Age						
17-24	0	518,904	0	0	518,909	0
25-29	7	564,831	0.01	4	564,850	0.01
30-34	8	480,883	0.02	3	480,898	0.01
35-39	7	339,019	0.02	2	339,045	0.01
40-44	5	141,586	0.04	2	141,605	0.01
45-49	1	40,559	0.02	2	40,568	0.05
50-54	0	6,785	0	0	6,785	0
55-59	0	982	0	0	982	0
60+	0	265	0	0	265	0
Sex						
Female	4	125,945	0.03	0	125,954	0
Male	24	1,967,869	0.01	13	1,967,953	0.01
Race						
Black	10	493,927	0.02	1	493,960	0
White	15	1,387,481	0.01	9	1,387,528	0
Other	2	119,773	0.02	3	119,784	0.03
Unknown	1	92,632	0.01	0	92,635	0
Number of Deployments during follow-up						
1	28	1,944,450	0.01	13	1,944,522	0.01
2	0	141,299	0	0	141,319	0
3	0	7,758	0	0	7,758	0
4	0	307	0	0	307	0
5+	0	0	0	0	0	0
Cumulative number of years deployed during follow-up						
<1	28	2,030,487	0.01	13	2,030,573	0
1-<2	0	58,520	0	0	58,527	0
2-<3	0	4,252	0	0	4,252	0
3-<4	0	548	0	0	548	0
4+	0	6	0	0	6	0

Appendix D: 1998-2018 Deployed cohort: Case count, person-years, and incidence rate (per 1,000 person-years) of each respiratory condition by demographic characteristics

Variable	Acute Upper Respiratory Infections			Chronic lower respiratory diseases			Bronchitis		
	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate
Total Population	1,625,327	9,021,817	180.16	52,087	8,616,061	6.05	17,381	8,862,340	1.96
Service									
Army	544,122	3,193,841	170.37	23,244	3,003,550	7.74	7,313	3,126,602	2.34
Navy	332,979	2,385,588	139.58	10,347	2,304,962	4.49	3,487	2,355,694	1.48
Air Force	624,756	2,324,262	268.8	14,114	2,227,909	6.34	5,069	2,282,047	2.22
Marine Corps	118,070	1,091,702	108.15	4,241	1,054,441	4.02	1,437	1,072,190	1.34
Coast Guard	5,400	26,424	204.36	141	25,200	5.60	75	25,807	2.91
Age									
17-24	367,751	2,209,392	166.45	13,483	2,150,868	6.27	3,826	2,184,843	1.75
25-29	520,228	2,756,226	188.75	15,792	2,644,293	5.97	5,232	2,712,404	1.93
30-34	372,088	1,967,773	189.09	10,396	1,866,336	5.57	3,812	1,927,934	1.98
35-39	225,379	1,248,999	180.45	7,218	1,173,909	6.15	2,643	1,220,515	2.17
40-44	99,993	587,261	170.27	3,497	548,129	6.38	1,274	572,201	2.23
45-49	30,905	194,887	158.58	1,230	180,472	6.82	436	189,174	2.30
50-54	7,414	47,122	157.34	370	42,981	8.61	129	45,542	2.83
55-59	1,414	8,800	160.68	90	7,853	11.46	25	8,420	2.97
60+	155	1,357	114.19	11	1,221	9.01	4	1,307	3.06
Sex									
Female	338,502	1,089,106	310.81	10,252	995,703	10.3	3,332	1,055,975	3.16
Male	1,286,825	7,932,711	162.22	41,835	7,620,358	5.49	14,049	7,806,364	1.80
Race									
Black	280,114	1,623,037	172.59	11,074	1,528,185	7.25	2,814	1,596,840	1.76
White	1,120,302	6,124,418	182.92	33,921	5,870,739	5.78	12,187	6,013,104	2.03
Other	119,238	711,250	167.65	3,607	683,265	5.28	1,251	699,818	1.79
Unknown	105,673	563,111	187.66	3,485	533,873	6.53	1,129	552,577	2.04
Number of Deployments during follow-up									
1	797,438	4,002,904	199.21	36,348	3,825,425	9.50	12,081	3,933,551	3.07
2	511,071	3,078,358	166.02	12,065	2,937,297	4.11	4,052	3,023,029	1.34
3	212,692	1,344,166	158.23	2,872	1,281,182	2.24	956	1,319,721	0.72
4	66,719	409,437	162.95	594	391,986	1.52	215	402,338	0.53
5+	37,407	186,952	200.09	208	180,172	1.15	77	183,700	0.42
Cumulative number of years deployed durin									
<1	1,091,855	5,590,290	195.31	39,712	5,360,365	7.41	13,225	5,498,486	2.41
1-<2	423,959	2,641,892	160.48	10,337	2,512,331	4.11	3,489	2,590,799	1.35
2-<3	93,624	669,638	139.81	1,790	630,591	2.84	601	655,489	0.92
3-<4	13,387	101,722	131.60	193	95,572	2.02	54	99,630	0.54
4+	2,502	18,275	136.91	55	17,202	3.20	12	17,935	0.67

Variable	Chronic bronchitis			Emphysema			Other COPD		
	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate
Total Population	1,010	9,017,244	0.11	552	9,019,089	0.06	1,687	9,016,154	0.19
Service									
Army	511	3,191,552	0.16	246	3,192,867	0.08	756	3,191,533	0.24
Navy	199	2,384,663	0.08	149	2,384,839	0.06	333	2,384,512	0.14
Air Force	222	2,323,294	0.10	107	2,323,552	0.05	520	2,322,290	0.22
Marine Corps	75	1,091,348	0.07	47	1,091,417	0.04	72	1,091,437	0.07
Coast Guard	3	26,387	0.11	3	26,413	0.11	6	26,382	0.23
Age									
17-24	162	2,208,997	0.07	104	2,209,084	0.05	137	2,209,136	0.06
25-29	219	2,755,293	0.08	117	2,755,523	0.04	287	2,755,369	0.10
30-34	218	1,966,638	0.11	114	1,967,083	0.06	330	1,966,497	0.17
35-39	211	1,247,947	0.17	80	1,248,497	0.06	370	1,247,647	0.30
40-44	120	586,616	0.20	81	586,956	0.14	335	586,163	0.57
45-49	50	194,612	0.26	38	194,734	0.20	133	194,339	0.68
50-54	23	47,028	0.49	17	47,062	0.36	70	46,925	1.49
55-59	5	8,763	0.57	0	8,795	0.00	20	8,732	2.29
60+	2	1,349	1.48	1	1,354	0.74	5	1,346	3.72
Sex									
Female	151	1,088,182	0.14	44	1,088,948	0.04	195	1,088,440	0.18
Male	859	7,929,063	0.11	508	7,930,141	0.06	1,492	7,927,714	0.19
Race									
Black	158	1,622,250	0.10	72	1,622,733	0.04	244	1,622,133	0.15
White	742	6,121,239	0.12	428	6,122,308	0.07	1,272	6,120,279	0.21
Other	55	710,989	0.08	28	711,024	0.04	76	711,000	0.11
Unknown	55	562,768	0.10	24	563,023	0.04	95	562,742	0.17
Number of Deployments during follow-up									
1	667	4,001,024	0.17	340	4,001,723	0.08	1,098	4,000,313	0.27
2	252	3,076,735	0.08	168	3,077,488	0.05	435	3,076,613	0.14
3	71	1,343,288	0.05	34	1,343,672	0.03	125	1,343,131	0.09
4	12	409,287	0.03	5	409,318	0.01	21	409,208	0.05
5+	8	186,911	0.04	5	186,888	0.03	8	186,889	0.04
Cumulative number of years deployed during follow-up									
<1	730	5,587,773	0.13	394	5,588,615	0.07	1,222	5,586,925	0.22
1-<2	219	2,640,406	0.08	127	2,641,088	0.05	368	2,640,262	0.14
2-<3	51	669,144	0.08	28	669,444	0.04	89	669,059	0.13
3-<4	9	101,659	0.09	2	101,678	0.02	4	101,635	0.04
4+	1	18,263	0.05	1	18,264	0.05	4	18,272	0.22

Variable	Asthma Cases (N)	Person-Year	Incidence Rate	Bronchiectasis Cases (N)	Person-Year	Incidence Rate	Chronic sinusitis Cases (N)	Person-Year	Incidence Rate
Total Population	35,578	8,803,473	4.04	215	9,020,911	0.02	34,762	8,764,083	3.97
Service									
Army	16,783	3,081,196	5.45	91	3,193,525	0.03	12,952	3,101,911	4.18
Navy	6,725	2,340,327	2.87	42	2,385,381	0.02	6,341	2,338,723	2.71
Air Force	9,126	2,279,822	4.00	56	2,324,017	0.02	12,828	2,223,274	5.77
Marine Corps	2,876	1,076,221	2.67	25	1,091,567	0.02	2,481	1,074,951	2.31
Coast Guard	68	25,907	2.62	1	26,422	0.04	160	25,224	6.34
Age									
17-24	9,696	2,179,554	4.45	31	2,209,297	0.01	5,674	2,187,479	2.59
25-29	10,992	2,695,482	4.08	50	2,756,050	0.02	10,402	2,695,044	3.86
30-34	6,846	1,912,964	3.58	45	1,967,562	0.02	8,545	1,897,733	4.50
35-39	4,701	1,207,621	3.89	42	1,248,799	0.03	5,892	1,192,219	4.94
40-44	2,234	566,129	3.95	27	587,128	0.05	2,893	555,402	5.21
45-49	822	187,201	4.39	11	194,849	0.06	1,038	183,066	5.67
50-54	228	44,931	5.07	5	47,093	0.11	258	43,841	5.88
55-59	57	8,309	6.86	4	8,778	0.46	53	8,042	6.59
60+	2	1,280	1.56	0	1,355	0.00	7	1,256	5.57
Sex									
Female	7,794	1,031,574	7.56	36	1,088,950	0.03	7,552	1,023,444	7.38
Male	27,784	7,771,899	3.57	179	7,931,961	0.02	27,210	7,740,639	3.52
Race									
Black	8,720	1,558,182	5.60	42	1,622,864	0.03	5,597	1,582,431	3.54
White	21,948	6,002,605	3.66	138	6,123,804	0.02	24,925	5,939,046	4.20
Other	2,486	696,574	3.57	17	711,190	0.02	2,062	696,240	2.96
Unknown	2,424	546,111	4.44	18	563,053	0.03	2,178	546,366	3.99
Number of Deployments during follow-up									
1	24,591	3,905,603	6.30	129	4,002,453	0.03	23,153	3,890,238	5.95
2	8,413	3,002,471	2.80	68	3,078,096	0.02	8,626	2,992,753	2.88
3	2,028	1,310,823	1.55	14	1,344,016	0.01	2,236	1,304,151	1.71
4	417	400,499	1.04	2	409,396	0.00	499	396,460	1.26
5+	129	184,078	0.70	2	186,950	0.01	248	180,481	1.37
Cumulative number of years deployed during follow-up									
<1	26,722	5,468,539	4.89	145	5,589,756	0.03	26,658	5,430,400	4.91
1-<2	7,364	2,572,012	2.86	59	2,641,598	0.02	6,712	2,566,378	2.62
2-<3	1,286	647,321	1.99	9	669,578	0.01	1,208	650,688	1.86
3-<4	157	97,968	1.60	1	101,710	0.01	142	98,853	1.44
4+	49	17,634	2.78	1	18,268	0.05	42	17,763	2.36

Variable	Pulmonary eosinophilia, NEC			Respiratory Symptoms		
	Cases (N)	Person-Year	Incidence Rate	Cases (N)	Person-Year	Incidence Rate
Total Population	280	9,020,324	24.43	220,419	9,021,817	24.43
Service						
Army	113	3,193,155	26.5	84,642	3,193,841	26.5
Navy	65	2,385,314	16.39	39,104	2,385,588	16.39
Air Force	58	2,323,945	34.46	80,089	2,324,262	34.46
Marine Corps	44	1,091,486	14.53	15,862	1,091,702	14.53
Coast Guard	0	26,424	27.32	722	26,424	27.32
Age						
17-24	87	2,209,130	19.58	43,259	2,209,392	19.58
25-29	66	2,755,796	24.06	66,304	2,756,226	24.06
30-34	50	1,967,430	25.05	49,294	1,967,773	25.05
35-39	31	1,248,770	26.49	33,084	1,248,999	26.49
40-44	31	587,109	31.75	18,644	587,261	31.75
45-49	10	194,830	36.94	7,199	194,887	36.94
50-54	4	47,110	44.63	2,103	47,122	44.63
55-59	1	8,799	52.04	458	8,800	52.04
60+	0	1,350	54.52	74	1,357	54.52
Sex						
Female	20	1,088,976	40.06	43,626	1,089,106	40.06
Male	260	7,931,348	22.29	176,793	7,932,711	22.29
Race						
Black	47	1,622,761	25.61	41,560	1,623,037	25.61
White	187	6,123,371	23.97	146,816	6,124,418	23.97
Other	23	711,192	25.45	18,101	711,250	25.45
Unknown	23	563,000	24.76	13,942	563,111	24.76
Number of Deployments during follow-up						
1	192	4,002,210	27.31	109,302	4,002,904	27.31
2	74	3,077,868	23.08	71,041	3,078,358	23.08
3	11	1,343,938	20.98	28,194	1,344,166	20.98
4	3	409,374	19.83	8,119	409,437	19.83
5+	0	186,934	20.13	3,763	186,952	20.13
Cumulative number of years deployed during follow-up						
<1	208	5,589,435	25.53	142,726	5,590,290	25.53
1-<2	65	2,641,433	22.84	60,348	2,641,892	22.84
2-<3	5	669,469	21.87	14,646	669,638	21.87
3-<4	1	101,716	21.72	2,209	101,722	21.72
4+	1	18,271	26.81	490	18,275	26.81